The Geometry and Symbolic Architecture of Basque Stone Octagons: The Pastoral Sarobe

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Published 2016

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0.0 Abstract

In the Basque Country (Euskal Herria) stone octagons, known as *sarobe* in Basque (Euskara), were built using specified dimensions, based on a "geometric foot" standard (0.278m). This standard was incorporated into a septarian system of measurements, e.g., rods of 7 g.ft. in length, called *gizabete*, and poles of 21 g.ft. The dimensions of the stone octagons suggest that ritual importance was attributed to their geometric design, to the size of their perimeter and their orientation. According to local tradition and Basque legal codes, the eight stones on the perimeter had to be oriented to the cardinal and inter-cardinal directions. Field work indicates that over 500 octagons may have existed inside Euskal Herria at some point in the past. In the study region the stone octagons are linked specifically to localized transhumant practices of Basque-speaking shepherds, well documented socio-cultural practices that appear to date back to the Late Bronze Age if not earlier. Inferential evidence suggests that the cognitive origins of their architectural design might reach back to the Neolithic and be related to similar pastoral traditions as well as septarian units of measure encountered along the Atlantic façade. Thus far, even though several of the sites have been Carbon-14 dated, the absolute *terminus ante quem non* of the design of the octagons is still uncertain.

1.0 Introduction

This chapter focuses on a little known cultural feature of Western Europe: the geometry and symbolic architecture of the Basque stone octagons. The investigation forms part of a larger ongoing project focused on European ethnomathematics. The latter has as its goal the recuperation of a pre-decimal metric metrological system whose cognitive and material remains are found throughout much of Western Europe, and most particularly along the Atlantic façade (Frank, 1999a, 1999b, 2008c). The architectural design and geometry of the Basque *sarobe* complexes serve as a valuable source of information concerning the type of septarian units of measurement manipulated by this pre-decimal metric system. The design of the sites also offers a window on cognitive strategies used in their construction.

Likewise, the continuity of social practices associated with the pastoral *sarobe* complexes allows us to reconstruct the way that the sites might have been used in times past, both practically and ritually. As will be demonstrated, the historically documented socio-cultural situatedness of the sites allows them to be integrated into a larger set of social practices. All of these elements, taken together, show a profound preoccupation with spatial orientation and the landscape, as well as the integraton of septarian units of measurement in a symbolic rather than a purely instrumental fashion. Moreover, as will be demonstrated, there appears to be a marked relationship between locations chosen for the stone octagon cultural complexes and the groups of megaliths that are often located in close proximity to them.

The present chapter concentrates on findings from archival research and field work conducted on the Basque *sarobe* stone octagon complexes over the past twenty years. The stone octagons are associated with a type of small scale transhumant pastoralism practiced in the Basque Country (Euskal Herria) until quite recently.[1] This type of transhumance was

[1] Euskal Herria is understood as the territory presently comprising the Autonomous Basque Community and the County Council of Navarre in Spain, and part of the Atlantic Pyrenees Department in France. Although

highly localized in that it had the shepherds and their flocks moving within a highly circumscribed area, up and down routes along the same slopes which allowed them access to the summer and winter pastures of the same valley. Fieldwork was conducted primarily in Gipuzkoa and Nafarroa, two of the seven Basque Provinces composing the modern day Basque Country (Euskal Herria). The findings reported in this chapter have been supplemented by the results of extensive fieldwork and archival research carried out by other investigators, such as Luis Mari Zaldua Etxabe (1996, 1997, 2006, 2007).

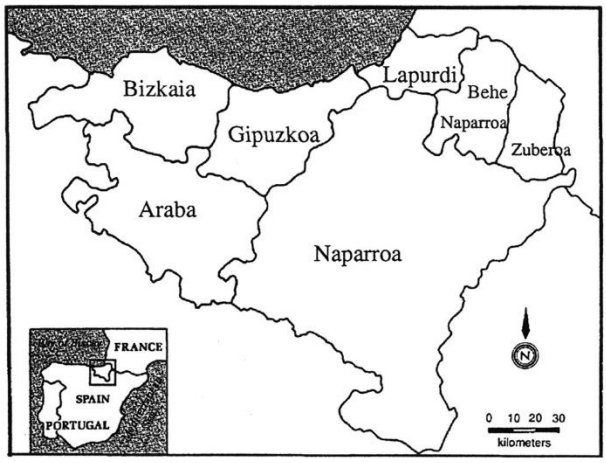

Fig. 1. Map of Euskal Herria.

Beginning with a general overview of the stone octagon phenomenon, the septarian units of measurement employed to lay them out are introduced.[2] Next the cultural emplacement of the sites is discussed; questions concerning the way they were designed are addressed and also the overall geographical distribution of the sites. Next, a rich exemplar composed of a clustering of stone octagon complexes is analyzed. In doing so, the spatial relationship holding between the sarobe sites and groups of megaliths found nearby is explored, particularly, the spatial contiguity of small stone circles, also referred to as *cromlechs* in French and Spanish. This section includes a statistical breakdown of the spatial distribution of a concrete set of stone octagons having megalithic sites in their immediate proximity.

The distributional ratio suggests that the proximity of the megaliths to the sites where the shepherds and their flocks bedded down their flocks is not merely fortuitous. Quite the contrary the sites are environmentally privileged locations that would have been chosen by shepherd collectives in times past. The latter consideration, in turn, leads to the hypothesis

this term has no present-day political meaning, it does have a significant cultural component (the Basque language) and territoriality, having been used in writing since the 16th century (Ioannes Leiçarraga, 1571). Cf. Zaldua (1997: 95).

[2] A highly condensed version of the septarian units of measurement discussed here is available in Spanish (Frank, in prep.-c).

put forward earlier by Barandiaran in the 1950s, Bahn in the 1980s[3] and more recently by Zaldua Etxabe (1996, 1997, 2006) and Frank (1996, 1999c, 2008c), namely, that the populations who constructed the megalithic sites were engaged in localized transhumant pastoralism.

The final section addresses the applicability of this hypothesis to other zones of the Atlantic façade and the possible pastoral socio-cultural situatedness of megaliths such as Avebury, in short, the possibility is brought forward that the Basque stone octagons have significant value as a heuristic, as a means of rethinking the functions that might have been associated with similar configurations in other parts of Europe, most especially along the Atlantic façade where there is evidence for the same type of septarian units of measurement (Frank, 2016).

2.0 General overview

In the rural zones where localized transhumant shepherding practices have survived, stone octagons called *sarobe* in Basque (Euskara) have continued to be utilized and surveyed. The localized nature of the transhumant pastoralism practices under consideration should be noted: the cyclical movement of the animals and their keepers involved them traveling from lowlands to the highlands of the same valley. As a result, the movement of shepherds and their flocks was confined to very narrow geographical zone. The octagons themselves were constructed originally within the limits of the "common lands" and represented the multipurpose space within which the shepherds of each social collective or *olha* were required to build their huts and corrals. The sites, rather than being private property, constituted land held in usufruct by the shepherd collective and with explicit authorization from the relevant authority, often the municipality itself.

Over time, some of the stone octagons passed into private hands, a process that allowed them to evolve into farmsteads, i.e., farmsteads whose boundaries are still delimited legally today by the perimeter stones of the octagons; in other instances they came to form part of land holdings of monasteries, although many other instances the sites continued functioning as part of the common lands of municipalities. In all these cases, the legal status of the stone octagons was maintained, that is, they continued to be recognizable entities with specific dimensions and acknowledged boundaries (Zaldua Etxabe, 2006). The pastoral unit itself, comprised of the shepherds and their sheep, spent the summer months in the highland *sarobe* with the shepherds tending their flocks and making large "mountain cheeses". At the end of the season the cheeses were divided equitatively among the families participating in the cooperative endeavor, according to a mathematical formula based on the number of milking ewes contributed by each member of the collective (Ascher, 1998, 2002; Frank, in prep.-e; Ott, 1979, 1981). Traditionally, each stone octagon had its own

[3] Cf. Barandiaran (1953) and Bahn (1983).

distinctive name (*Fig. 2*), while the members of the collective often were known by the name of their stone octagon rather than their family name.

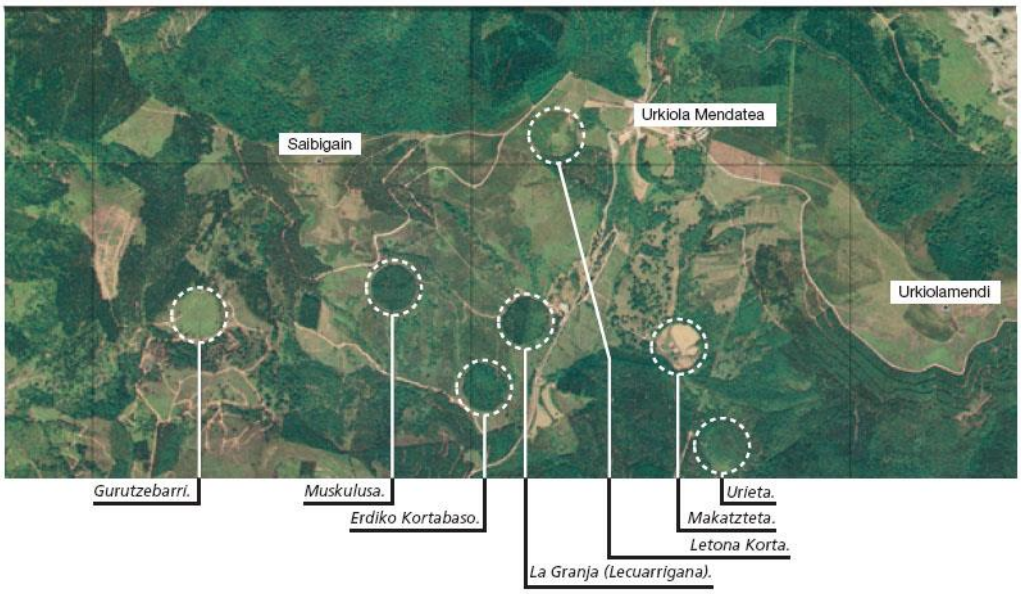

Fig. 2. Stone octagons in Abadiño, located inside the Parque Natural de Urkiola in Bizkaia. Source: Zabala (n.d.).

According to custom and, later, written law codes, during the daylight hours the animals and their keepers had access to pastures of the common lands; each night the shepherd group had to return with its flock to the confines of the group's own stone octagon to bed down (Arregi, 1980; Díaz de Durana & Larrea Rojas, 2002). During the winter period members of each transhumant pastoral collective inhabited their lowland winter *sarobe*. At the beginning of May they would drive their sheep and other livestock up to their summer *sarobe* in the highlands, only to journey back down to the winter stone octagon in the valley at the beginning of November.

The *sarobe* constructions, initially thought to be unique to the Basque geographical zone, form part of a larger and more widespread body of knowledge and social practice associated with transhumant pastoral practices in other parts of Europe. For example, a similar parceling of grazing lands is found across the Cantabrian façade of the Iberian Peninsula, in Santander, Asturias and Galicia.[4] Evidence for their existence extends north into France and south into Spain as far as Extremadura (Caro Baroja, 1973: 177-182; Garcia Alonso, 1997; Haristoy, 1883-84: 551 ff.; Lecuona, 1959: 297-300; Oria M-Conde

[4] Caro Baroja states the following: "Las 'lamas' de Galicia son también propiedades comunales destinadas exclusivamente a pastos, que se arriendan o se usan por vecinos, según indica Nicolás Tenorio, *La Aldea gallega*, págs. 18-20." ["The 'lamas' of Galicia are also comunal properties destined exclusively for pasture, that are rented or used by neighbors, as indicated by Nicolás Tenorio, *La Aldea gallega*, pages 18-20.] (Caro Baroja, 1973: 181-182). Tenorio's book (1914) is a study of common law and popular economy, written between 1900 and 1906, and published in Cadiz, in 1914.

& Fernández Acebo, 1997).[5] While there is evidence of similar parceling of pasturelands as far away as Extremadura, it appears to be a phenomenon that was concentrated in the Franco-Cantabrian zone of the Iberian Peninsula, a least initially since this is the zone in which documentation for these practices is most abundant. And within the zone in question, the most extensive documentation is found in Euskal Herria. Among these data sets there are those that allow us to see how the sites were laid out, that is, their geometric design and the type of units of measurement utilized, topics that will be taken up shortly.

Indeed, it is only in Euskal Herria where we find extensive archival resources and material artifacts that allow us to carefully document the manner in which the septarian units of measure were used in the construction of the stone octagons.[6] Likewise, traditions associated with their geometric design and the socio-cultural embeddedness of the units fit into a larger pattern of recognized social practices. These relate, in turn, not only to activities in the socio-economic domain, but also to judicial-political aspects of the pastoral collectives. Finally, there is the question of how the Basque stone octagons relate to megalithic monuments that are frequently found nearby, especially cromlechs. Indeed, there is reason to believe that the latter structures may have played an important role in the overall cultural complex associated with the stone octagons (Frank, 2001a, 2008c).

In other parts of the Atlantic façade, we find clear evidence that septarian units were traditionally used, suggesting a continuity of metrological practice across this zone and particularly its association with pastoral practices. It followers, therefore, that in times past septarian units, such as the 21 ft. *perch*, may have structured practices of transhumance and the laying out of traditional landholdings in this geographical region, most particularly in Ireland, Wales, England, Scotland and Normandy, given the nature of the evidence currently available (Garnier, 1986; Hadingham, 1975; MacKie, 1977; McKerral, 1943-1944). In sum, in Euskal Herria the stone octagons are intimately linked to transhumant practices of the Basque-speaking shepherds while the absolute *terminus ante quem non* of the design of the octagons themselves is quite uncertain. Likewise, there is no way of determining when these septarian units of measure were first used in the Atlantic façade.

2.1 Theoretical considerations

References to the Basque *sarobe* are found in the earliest medieval records. However, given their employment by transhumant pastoral groups to set out clearings within the common woodlands and pastures, the Basque stone octagons may date back to much earlier pastoral practices. Likewise, there is the numerical importance assigned to septarian units of measurement—multiples of 7—e.g., the use of the 7 ft. staff, a 49 ft. "knot" and a 21 ft pole. Thus, the sociocultural emplacement of sarobe along with the units of measurement

[5] In a separate document I will discuss the various etymologies that have been proposed to explain the different names given to these parcels, e.g. *sarobe, saroe, sarobi,* and *saroi* in Gipuzkoa, and also by *soro* in Araba and Nafarroa.

[6] The term *sel* and its etymology is addressed in section 9.0 of this study.

that characterize it, provides a kind of cognitive template, a means of identifying the presence of similar cultural artifacts embedded in transhumant traditions of Europe, particularly along the Atlantic façade. Moreover, by adopting such a methodological gridwork, the results of such a search could contribute significantly to investigations of the ethnomathematical traditions of these regions.

That such a metrological tradition was preserved so effectively over such a long period of time also suggests that this Basque cultural assemblage deserves to be investigated in much greater detail. Undoubtedly one of the major factors contributing to the preservation of these metrological traditions has been the fact that until quite recently in Basque-speaking zones such traditional mathematical knowledge has been transmitted orally and, hence, through embedded mechanisms, "hidden" or "frozen" in the objects and artifacts utilized (Gerdes, 1997; Zaldua Etxabe, 1996).

Fig. 3. Limits of the Basque-speaking zone, first century A.D. Source: Adapted from Salvi (1973); Bernard & Ruffié (1976).

This approach also provides a broader, more productive view of culture, one that includes technology and artifacts as part of a distributed cognitive system. Furthermore, the approach offers a means of studying the evolution of specific cultural artifacts across time, focusing on a given lineage of artifacts.

Stated differently, rather than being codified explicitly in written treatises, Basque metrological traditions represent a form of "distributed cognition" (Hutchins, 1995, 2001, 2005), collective knowledge embedded implicitly, in this case in the architectural design of the stone octagons and in the "cultural conceptualizations" that supported them

(Sharifian, 2008). This non-codified form of embodied geometrical knowledge requires a careful examination of the material artifacts and social practices that preserve these earlier mathematical understandings. These entities act as "material anchors" and represent examples of the off-loading of collective understandings held at the group level in times past.

In order to better understand the concept of "material anchors" and "material metaphors" we can turn to Bono (2001). He has referred to the process of embedding mathematical and other sorts of understandings in material artifacts as the production of "material metaphors", instruments for thinking and the transmission of knowledge:

> With this notion of metaphor in mind, we can reimagine Pickering's temporally emergent 'practice' as a process whereby the 'models' embedded in the material practices, machines, and instruments of science and projected onto the material objects and agencies in nature are themselves instantiations of metaphors. They are, in effect, metaphors put into—or translated into—material actions and things. Put differently, we can say that the materialities of scientific practice—machines, instruments and protocols, and objects—are discursively configured and deployed through the metaphors embedded in and operating through them. (Bono, 2001: 228)

Bono goes on to observe that a "good example of scientific instruments and protocols embedding metaphoric models is the now ubiquitous Flourescent Activated Cell Sorter (FACS), which embeds in its design the informational metaphorics of molecular biology, thus tending to favor the skill-set and interpretive modalities of the molecular over the morphological approach to immunology" (Bono, 2001: 228). He then concludes the following which is particularly applicable to the case of the stone octagons, their socio-cultural situatedness and the septarian metrological system that informs them:

> The world as we know it and operate upon it is one in which we continually cojoin discourse and practice, text and action; where we simultaneously learn *and* act by embodying intentions and projecting our metaphorically constructed models onto matter which we shape and use to our ends as *instruments* of thought and action. The world as we know it and study it is filled with material-textual, or material-discursive, hybrids—instruments; machines; illustrations; diagrams; maps; charts; physical models; computer simulations—that are simultaneously part of the material world and *instruments* of our knowing and manipulating it. They are all, in their own way, what I like to call *material metaphors*: embodied *metaphors-in-action.* (Bono, 2001: 228).

Viewed from this vantage point and understood as "material metaphors", the stone octagon cultural complexes incorporate knowledge that would otherwise be inaccessible to us. Instead of being explicitly expressed, the knowledge is embedded directly in the artifacts and related social practices, and has been transmitted in this manner across time through mechanisms typical of oral cultures. As such, from this perspective, there is a fusion of beliefs and practices in the material artifacts in question. The stone octagon both embodies and reflects these previous understandings and cultural conceptualizations.

In the case of the stone octagons, we are confronted with processes whereby the pre-existing conceptual model was embedded in material practices, poles and ropes, units of measurement and related instruments utilized in laying out the stone octagons. This model along with the geometric and scientific skills associated with it was projected onto these

material objects. By means of a thorough examination of these material anchors—the artifacts, metrological traditions and social practices associated with the *sarobe*—we will be able to extrapolate, albeit hypothetically, the pre-existing conceptual model and the geometric and mathematical cognitive strategies that were utilized originally in its construction.

2.2 Units of Measurement

The units of measurement utilized in the construction of the *sarobe* are well documented, although their correspondences are not familiar to most Basque-speakers today. The following are among the most important ones encountered in the documents.

2.2.1 The *geometric foot* and the *vara*

The base unit of measurement employed in the *sarobe* of Gipuzkoa is the "geometric foot". In practice this unit is equivalent to 1/3 of the *vara de Castilla* (Frank, 1999b). In 1568 the latter *vara de Casilla* replaced the *vara de Toledo* as the official standard and ruler for Spain and its colonies abroad (S. Múgica, 1919, Ley I, tít. XIII, lib. V) . The length of the *vara de Castilla* coincides with that of the bar standard of the Basque provinces of Gipuzkoa y Bizkaia. These rods date back to the Middle Ages, if not earlier, and are derived from the same metrological traditions (Martínez Gómez, [1795] 1816).

2.2.2 The *gizabete* and the *toise*

In addition to being used in multiples of three, as in the *vara*, the so-called "geometric" foot was the basis of the 7 g.ft. unit of measurement called *gizabete* in Basque and *toise* in French. Moreover, it was this 7 g.ft. measuring rod that was employed by French astronomers at the end of the 18th century to carry out the measurements of the earth's quadrant which eventually led to the invention the modern day decimal metric system. However, in France, the *toise* unit had been converted centuries earlier into 6 *pieds du roi* (king's feet or royal feet). These *royal feet* were sometimes referred to as *pieds de Paris*. Consequently, at the time of the invention of the decimal metric system, in France the *toise* was viewed as a unit of measurement operating within a sexagesimal system (Frank, 1999a, 1999b).

That the 7:6 ratio holding between the two standards was common knowledge is clearly documented in the historical record. For example, in his report dating from 1736, the Basque surveyor Villarreal de Berriz ([1736] 1973: 116-117) states:

> En un estuche tengo un pie real de París en bronce muy exacto, y aviéndolo medido, y cotejado muchas veces con el pie de Castilla, hallo, que 6 pies de París, que es la *toysa*, hace 7 pies justos de Castilla [In a case I have a royal foot of Paris, done in bronze, extraordinarily precise and having measured it and compared it many times with the foot of Castille, I find that 6 feet of Paris, which is the *toise*, are equal to precisely 7 feet of Castille.][7]

[7] All translations in this work have been done by the author, unless otherwise indicated.

Furthermore, the widespread awareness of the 7:6 ratio is demonstrated by the fact that Jorge Juan, the Spanish astronomer who measured the arc of the meridian in Peru, used it in his report on the 1752 expedition (García Franco, 1957: 82). Thus, the decimal metric system itself resulted from surveys conducted using the *toise* standard of 7 g.ft, a point overlooked by modern historians of science who have viewed the *toise* merely as being 6 "feet" in length. They have failed to recognize that these "feet" were "royal" and that the *toise* unit of measurement was linked to an earlier septarian number system. It is the latter septarian units of measure that were used by Basques in the construction of their stone octagons, long before the creation of the decimal metric standard (Frank, 1999a, 1999b).

In fact, we could argue that the decimal metric model itself is based, albeit indirectly, upon a septarian unit of measurement that in turn was entrenched in a larger set of metrological traditions. In order to bring this aspect of the data into clearer focus we need to examine the geographical diffusion of the septarian unit more closely. In Euskal Herria the unit is called a *gizabete* which translates as "full-man" or "whole-man"; in the rest of the Iberian Peninsula the unit went by various names: *estado*, *brazada*, *braza*, and *toesa*. Then in France a unit of the same exact length was called a *toise* (Carrión Arregui, 1996; Martínez Gómez, [1795] 1816; Zupko, 1978: 175-176). The *toise* was the official pre-decimal metric standard of France and by the middle of the 18th century it was functioning as the "linear measure most commonly used by the royal armies and navies as well as in mathematical works in Spain, Italy, and a large part of the rest of Europe" (García Franco, 1957: 76).[8]

In short, given its widespread usage, we may state that in practice the *toise* functioned as the pre-decimal metric standard for most of Europe. As a result, in the 18th century when astronomers from various nations undertook surveys to determine the length of 1° of meridional arc at different latitudes, their astronomical calculations were carried out using the *toise.* Yet the length of that bar standard corresponds precisely to the length of the septarian *gizabete* unit used to lay out the stone octagons. As such, the French bar standard, used in the elaboration of the decimal metric system, appears to hearken back to earlier septarian-based units and metrological practices found along the Atlantic façade which, in turn, appear to date back to the beginning of the Christian era if not earlier (Frank, 1999a, 1999b, 2008c).

2.2.3 The *hogeitabatoin/postura* unit of measurement

The seven-foot shepherd's staff called *gizabete* is related to another septarian unit of measurement, namely, a 21 g. ft. pole, a unit found throughout much of Europe with evidence for its usage being particularly abundant along the Atlantic facade. Basques traditionally used this 21 g. ft. pole to lay out their land holdings. The unit is referred to as

[8] "[La *toesa* era] la unidad lineal más comúnmente usada por los reales Ejércitos y Armadas, así como en todos los trabajos matemáticos de España, Italia y gran parte de Europa."

hogeitabatoin in Basque, *postura* or *pértiga* in Spanish, *perche* in French[9] and *perch* in English.[10] Again, the fact that this septarian unit of measurement is found outside the Basque region, especially along the Atlantic façade, suggests that other septarian units were also in use in the same zone. Likewise, it follows that pre-decimal metric system that has survived in Euskal Herria and was employed in laying out the stone octagons once had a wider geographical extension.

2.2.4 The *gorapila* "knot" unit

In keeping with the traditional septarian measurement system, Basque surveyors worked with poles of different lengths such as the 7 g.ft. *gizabete*, the 14 g.ft. *hamalau-oin* and the 21 g.ft. *hogeitabat-oin*. They also employed a 49 g.ft. unit called *gorapila* to lay out their stone octagons. In Euskara the term *gorapila* means "knot". The *gorapila* unit was embodied in a cord in which threads of two different colors, red and blue-black, were woven. One set of the colored threads was placed every seven g. ft. while the other set marked the next larger unit, namely, seven units of seven g. ft., i.e., each unit of 49 g. ft. The term *gorapila*, therefore, refers to the "knots", and/or more concretely to the threads that were woven into the rope marking off each unit of 49 g.ft.. These ropes were carefully guarded and used for surveying purposes.[11]

Although the exact way that the gorapila unit cord was stored is not fully documented, it appears that it was rolled up on portable device. While images of the gorapila rope itself are not currently available, the following *neurrikordel* "measuring cord" is representative of the way in which the colored threads were woven into the gorapila rope at given intervals to mark off the units of measurement. This type of *neurrikordel* cord was still in use forty years ago in rural areas where it was employed to determine the weight of livestock. It was stretched tight around the animal's girth and then by means of a simple mathematical conversion of the results of the physical examination, the animal's weight could be

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[9] It should be noted that in France the *perche* was finally set at 18 *pieds du roi*, after centuries of conflict over its correct length (Grierson, 1972: 19; Zupko, 1978: 129-131), conflict motivated in part by the presence of "feet" of differing lengths and confusion on the part of those who were more accustomed to using traditional septarian equivalencies. In the end the *perche* was defined as "18 pies de roi" which allowed it to retain its original length because the equivalency 7:6 holding between the two kinds of "feet". Thus, the resulting *perche* unit of 18 *pied du roi* or *de Paris* ends up being nothing more than "21 g.ft.", that is, length was the same as the *pértiga* of "21 common feet of Castille" on the other side of the border. This might also explain why in some locations in Euskal Herria documents speak of the practice of laying out stone octagons using a *pértiga* of "18 pies" (Zaldua Etxabe, 2008a).

[10] Also, it should be noted that the old Irish acre "was measured by a perch of seven yards or 21 feet in length" (McKerral, 1943-1944: 47).

[11] There is another type of surface unit based on 70 and its multiples, such as the *gizalan*, also called *epaile*, a 4900 sq. g.ft. surface measure. The latter septarian (or septuagesimal) unit is identical to the so-called *peonada*, documented from the Middle Ages forward and still in use today in various parts of the Iberian Peninsula. The *peonada* as well as the *gizalan / epaile* was utilized both as a concrete land measure and abstractly as a mechanism for calculating recompense for communal tasks, fines and other forms of recompense (Frank, 2001b; Gudeman, [1978] 2004).

ascertained quite accurately. The device is mentioned as early as 1237 in the *Fuero general de Navarra* (Cap. VI, Lib. V) in an article of the law code containing a detailed description of how any two combatants were to be measured. This process of measuring each combatant in public view was done in order to ensure that they were of equal size and weight before taking part in ritual combats intended to prove the guilt or innocence of the party they were representing.

Fig. 4. A n*eurrikordel* from a farm in the vicinity of Zarautz.

Although we do not have a great deal of information concerning the apparatus upon which the gorapila cord was stored and transported when it was used to lay out the stone octagons, there is reason to believe that the apparatus differed little from the spool that stored its nautical counterpart since the gorapila unit was also integrated into the system used to estimate the speed of crafts at sea and on rivers. The device, known as an *ontziska* or "little boat", consisted of a wedge-shaped wooden float attached to the end of a cord that, in turn, was wound around a spool so that the cord could be easily released when needed (*Fig. 5)* (Garmendia Berastegui, 1992: 60). Because of its wedge shape, the float would "grab" the water and start pulling out rope as the vessel moved forward.

In order to calculate the speed of the craft in the water, two people were involved. First, there was an individual who was in charge of throwing the "chip-log", as the wooden floater on the cord is called in English. When this device was thrown aft, an initial uncalibrated extension of the cord, called a "spray line", allowed it to be tossed far enough behind the boat so that it landed beyond the boat's wake. As the end of the "spray line" portion of the rope passed over the taffrail, the person called out and the other person would invert his log-glass sharply, the sand-glass used to keep track of time. As the boat moved forward, the spool turned, releasing more lengths of the cord from the reel. At the same time the person, holding the spool over his head and would count the number of "knots" as they payed out. Meanwhile the second person was in charge of keeping careful track of the time, using a sand-glass or, earlier, a rhythmic chant, to establish a fixed period of time,

usually 28 seconds.[12] Just as the last particle of sand passed from the top to the bottom of the glass, the person called out and the other would seize the log-line which had been running out freely. Thus, when the time was up, the velocity would be calculated by the counting the number of "knots" that had played off the spindle.[13] Using a simple mathematical formula the speed of the boat in the water during one hour could be determined, if needed.[14]

The following drawing, reproduced from the work by García Franco (1947: 101), shows the device sitting in a wooden basket which allowed it to be transported from one location to another:

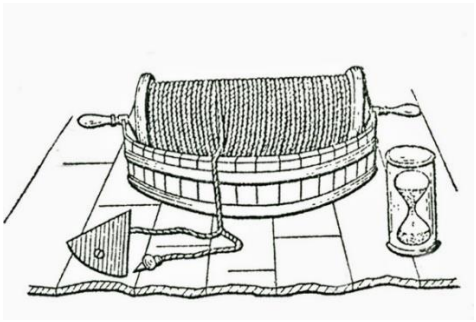

Fig. 5. A "chip log" with its spindle and sandglass. Source: García Franco (1947: 101).

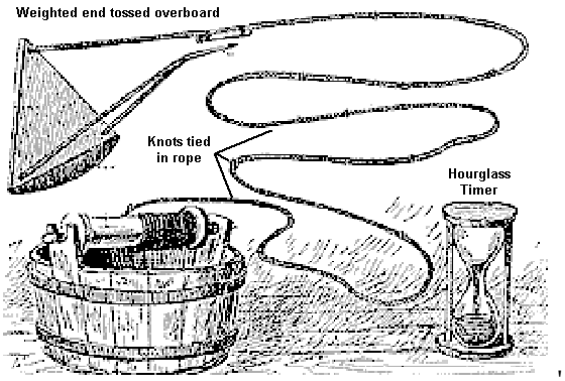

Fig. 6. Another view of the "chip-log". Source: http://www.aerospaceweb.org/question/history/knots/chip-log.gif.

[12] Most descriptions indicate that the timer counted only 28 seconds, but they assumed two more seconds were consumed in the act of starting and stopping the timer, loosening and stopping the paying out of the cord, bringing the total to 30 seconds. Obviously this was not a highly precise science.

[13] However, the use of a log did not give an exact measure of speed since a number of other considerations had to be taken into account, for example: the effects of currents and waves, the possible stretch of the cord when exposed to water and inaccuracies in timing the event itself. Taking frequent measurements of the craft's velocity and averaging them could offset these factors.

[14] In actual practice, since there were two types of "knots", those marking units of 49 g.ft. and those marking 7 g.ft., the individual who was in charge of recording the speed and direction of the vessel on the "traverse board"would indicate the speed of the boat by counting the number of both types of knots and inserting a peg into the appropriate slot on the board in order to keep a record of the boat's course.

In García Franco's illustration and in the photo of the device (below) housed in the Musée de la Marine in Paris (*Fig. 7*), there is no visual evidence of colored threads being woven into the cord itself. However, García Franco himself confirms their use: "El cordel está dividido en porciones iguales mediante trozos de lanilla de un color fuerte que se van afirmando entre las mallas; se las distingue por un nudo" [The cord is divided into equal segments by means of pieces of wool of a bright color that are woven into the mesh [of the cord]; [the individual segments] are differentiated by means of a knot […] (García Franco, 1947: 102). His description indicates that there were commonly two types of knots marked on the cord, small and large, with the large ones indicating units of 49 g.ft., understood as 7 subunits of 7 g.ft.: the end of the first segment had one knot, the end of the second two knots and so forth up to six knots, while the seventh segment was marked by a single large knot.

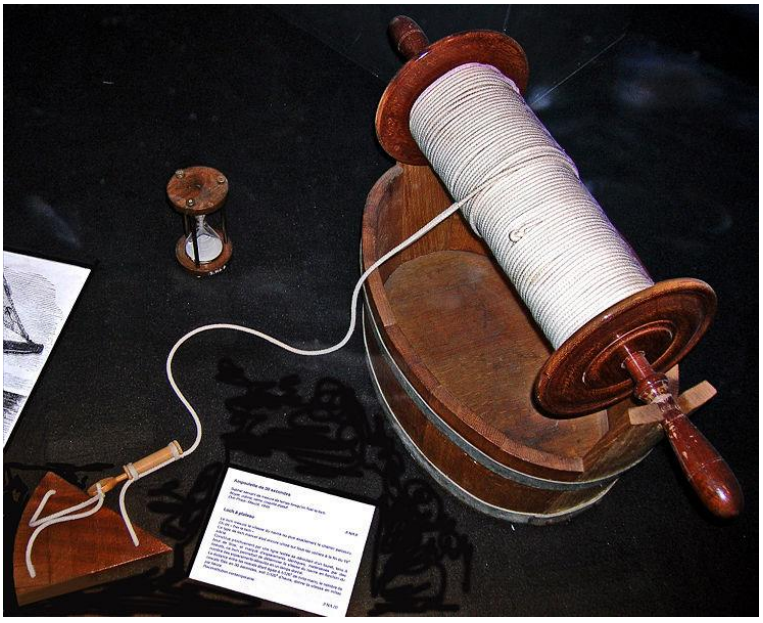

Fig. 7. Chip log from the Musée de Marine, Paris. Source: http://en.wikipedia.org/wiki/Chip_log.

In *Fig. 7* the cord merely appears to have been knotted at given intervals without having a visually distinctive way of perceiving the knots themselves. However, it is clear from whiteness of the cord in image (*Fig. 7*) that it does not correspond to the cord originally wrapped around the spool. Early descriptions of the device often do not give many details concerning the physical nature of the "knots", e.g., whether they were complemented by brightly colored woolen threads. For instance, Fournier speaks of the chip log explaining that the wedge itself was equipped with a small band of lead along the bottom edge—to keep it partially submerged yet upright in the water—and with a "cordeau au quel on fait des noeds de 7. brasses en 7 brasses" [cord on which knots are made every 7 by 7 *brasses*], but without indicating how these knots were made visible from a distance (García Franco, 1947: 100). In other words, we simply do not know whether earlier the

term “knot” always corresponded to precisely same physical object that it does in the Basque case, where the intervals appear to have been marked by different colored threads woven directly into the cord itself, thus insuring that the markers did not slip out of place and that they were easily visible even from a distance. On the other hand, keeping in mind the details afforded by García Franco’s description (1947: 101-103) is quite possible that a combination of woven colored threads and knots were originally used on land and at sea since one technique was to have the helmsman hold the cord, counting the knots as they slipped off the reel and through his fingers.

Once the log-line was thrown over the stern of the boat, the addition of lead weights to the bottom edge of the wooden wedge was important: they ensured that the log would semi-submerge and be oriented correctly in the water. That is, it would remain upright and act as a drogue, the latter being a device usually constructed to provide substantial resistance when dragged through the water, i.e., as it trailed behind the vessel on a long line. The added weight on the chip log provided for more resistance in the water and thus a more accurate and repeatable reading of speed. A bridle-like apparatus was attached in such a way that a sharp tug on the log-line resulted in one or two of the bridle's lines releasing, allowing the log to tip over and be retrieved with relative ease.

Stated differently, to retrieve the drogue, rather that reeling it in against the dead drag of the upright board, by giving the line a quick, very sharp tug, the peg, snugly fitted into the drogue, pops out, letting the board flip parallel to the flow of the water and allowing for easy retrieval as it skips across the surface of the sea.

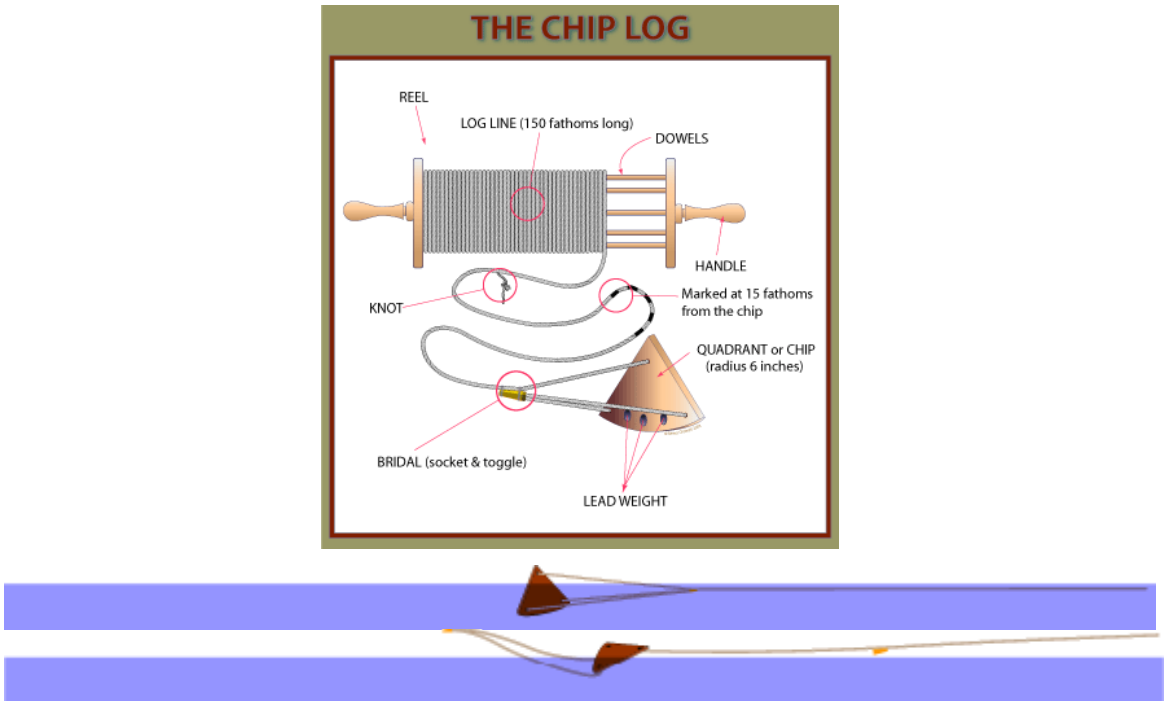

Fig. 8. A modern version of the chip log showing the uncalibrated portion called “spray line”. Source: http://www.schoonerunion.org/images/SU_chiplog.gif and www.schoonerunion.org/pages/chandlery.html.

In order to understand the significance the the nautical version of this unit of measurement has for our topic, namely, the geometry and architectural design of the Basque stone octagons, we need to return to our discussion of the 7 g.ft. *gizabete* which, as noted, was called *estado, brasa* or *brazada* in Spanish. . In nautical estimates of the speed of the craft, the term *nudo náutico* was used in Spanish, an expression that has its counterpart in the term "nautical knot" in English. However, as will be shown, the meaning of the term has changed over time. The French physical equivalent of the "nautical knot" was initially a distance of seven *brasse* marked by a knot on the rope.[15] This means that 7 units of 7 g. ft. each needed to be released from spool for 1 nautical knot of velocity to be attained. In order words, the number of units of 49 g.ft. spun off the spindle in a given amount of time—each "knot" being represented by the combination of knots and colored threads woven into the cord itself at 49 ft. intervals—allowed for the subsequent calculation of the velocity of the craft over one hour.

Over time, in Europe, the conceptual equivalency of "1 nautical knot" per hour came to be standardized in meters as "1 nautical mile" (1852m), which is 1/60 of a degree of meridional arc while the latter distance is based on modern calculations of the Earth's circumference. Therefore, although today there is no strict relationship between the *physical* distance between the knots on the cord and the value assigned to a nautical mile, the knotted cord came into being before an accurate reading of the Earth's circumference had ever been achieved. Stated differently, it is clear that the tradition of placing knots to mark every 49 g.ft. was a maritime practice that antedated the point in time when the value of a "nautical mile" was set at 1852m. Thus, today the term "knot" stands for or *corresponds* to the number of nautical miles covered in one hour: the semantic equivalent of one "knot" referred to the speed of the vessel, that is, an extrapolation from a physical object, a cord that contained "knots". To make this point somewhat clearer, if 1/60° is assigned a value of 1852m and the time period is 30 seconds for playing out the line, the distance between the knots on the cord must be multiplied 120 times to achieve the distance corresponding to 1/60° or 1852m.

In other words, if the notional definition of a speed of one "knot" is one "nautical mile", set at 1852m, then the value given to 1/60 of a degree must be divided into 120 segments, i.e., the distance covered in 1 hr., or stated differently, each of the 120 segments

[15] It should be noted that today the English "nautical knot"—as inscribed on the cord itself—is calculated in English feet and corresponded to 47 ft. 3 in. (14.4m), according to one source, while another states that the intervals used today are 50 ft. 6 in. each (15.39m). The first is equal to nearly 52 g.ft., while the second gives 55.37 g.ft., rather than the 49 g.ft. (13.62m), the length assigned to the gorapila unit. Then, whether each English "knot" on the cord is set at 47 ft. 3 in. or at 50 ft. 6 in, there still can be no even fractional divisions of it into feet. This contrasts to the earlier septarian system where the gorapila (*estado, braza, brazada*) unit was subdivided into equal parts, each of 7 g.ft. Finally, there is also an interpretation of the English system that says the cord was marked in "fathoms" of 6 English ft. each, with eight fathoms equaling one "knot", that is, the "knot" unit was equal to 48 English feet (Clwyd, 2008). For more discussion on the various attempts to set the length of the cord, cf. García Franco (1947: 99-103; 1957: 210-217).

must have been notionally equivalent to the distance between the knots on the chip-log cord. Using the modern value of 1852m per nautical mile, each segment, that is, the distance between each knot would be equal to 15.43m. This distance can be compared to the length of one Basque gorapila ("knot") composed of 49 g.ft and which, in turn, was equivalent to seven French *brasse*: 13.62m. Obviously, in this case we are talking about two different metrological traditions that merged, one calculated in geometric feet and another in meters, a topic that will be explored further in the following section.

2.2.5 Historical background: "nautical miles" and "leagues"

At the point in time when the notional length of the "nautical mile" came into fashion, in the 15th century, (i.e., as notionally 1/60° of the Earth's circumference even though the exact size of the Earth's circumference was still being debated), the navigational units of measurement were still "leagues" and thirds of "leagues", often referred to as "miles". Hence, the "nautical knots" emerged from a preexisting navigational system where distance was being measured in "leagues" and thirds of "leagues". Moreover, given that there was still neither agreement about the correct length of a league—countries used different lengths—nor the number of leagues in 1 degree of meridional arc, the merit of the notional definition of a "nautical mile" (or *milla marítima* as it was called in Spanish) as 1/60th of a degree was rather questionable (García Franco, 1957).

Although a detailed study of this aspect of maritime history is outside the scope of this chapter,[16] it is evident that the notional basis of 1/60th of a degree of meridional arc as a means of defining 1 "nautical mile" introduced a confusing element into a system such as the one used in the Iberian Peninsula, one that already had two types of "leagues", one for mapping on land and another for use at sea. These leagues were of different lengths and hence their "miles" or thirds of a league had different values. Into this mix came yet another type of "mile", the *milla marítima,* that was equal to 1/60th of a degree of meridional arc. The question, however, was what value should be assigned to this unit and therefore the exact value of the Earth's circumference, a value that was still being hotly debated in the 15th century and beyond. The nautical mile's notional definition as 1/60th of a degree of meridional arc appears to be linked to a widespread nautical convention which assigned 60 *millas*, each of 1,000 "pasos" (units of five feet), to 1° meridional arc. That convention, in turn, was one that assumed there were 20 "leagues", each of 4,000 feet (each a 1/3 of the *vara de Castilla*), in 1° meridional arc. These decimally-oriented leagues contrast with the septarian ones used by the Basques.

At the same time, given the decimal cognitive bias in the determination of league units (as multiples of 1,000 "paces"), the Basque septarian leagues are rarely discussed. Similarly, given the dominance of the French sexagesimal system and their *toise* bar and

[16] The coordinate system to which the Basque league belongs is treated in depth in another monograph (Frank, in prep.-d).

brasse of 6 *pieds du roi*, over time the underlying septarian basis of the "knots" employed in the chip log slowly disappeared from view. Yet the septarian system's presence is still clearly apparent in the underlying units of measurement inscribed into the cord used to calculate the speed of the vessel. The conceptual equivalent of "1 nautical mile" was 1 minute of meridional arc, which with increasingly refined measurements of the Earth's circumference came to be set at 1852m. In this respect it is noteworthy that at the end of the 17th century we find the work of Antonio Gaztañeta Iturribalzaga (1692) who held the position of Chief Pilot for the Spanish Royal Armada and wrote extensively on questions of celestial navigation and naval architecture. He insisted on the correctness of the septarian league and defended the value of the *ontziska* as a means of determining the speed of the vessel (García Franco, 1947: 103; 1957: 50-58), although he admitted that, for many decimally-based leagues were easier to manipulate.

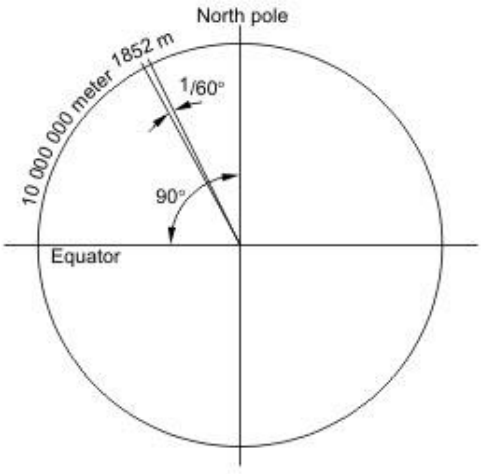

Fig.9. Notional definition of Nautical Mile. Source: Adapted from Wikimedia Commons http://en.wikipedia.org/wiki/Nautical_mile.

The conceptual basis for the modern "nautical mile" of 1852m can be best explained by saying that, in principle, it corresponds to the length of one minute of meridional arc at 45° of latitude. Hence, its actual length depends on the value given to the circumference of the Earth and the latitude chosen. Because of this fact, there were slight differences in the value assigned to it by various countries. Spaniards calculated its length in 1851.85m, basing that figure on the ten million meter assignment to the Earth's quadrant; in Italy the same length was used; in the United States it was 1853.248m, since they calculated 1/60° of the maximum circumference of the Earth on Clarke's spheroid; in England the nautical mile was set at 1853.17m which is the length of one minute of arc at the latitude of London (48°); and finally in 1906 France adopted the value of 1852m for it. The latter figure is the one that survives today and was adopted in 1929 after being proposed by the International Hydrographic Institute (García Franco, 1957: 203).

In summary, keeping in mind that the Spanish terms *estado*, *braza* and *brazada* referred to a seven foot unit of measurement and that the French term *brasse* (as well as

toise) had exactly the same physical length, it follows that initially this nautical unit of measurement was also septarian in nature and, furthermore, that the cord wrapped around the spindle was fundamentally identical in its conceptualization to the cord incised with gorapila "knots" used to lay out the stone octagons, a cord that was in all likelihood transported from one location to another on a similar spindle-like device *(Fig .4, 5, 6, 7)*.

Furthermore, as was the case with the other septarian units of measurement, the equivalency given to the "nautical knot" shows up both in Spain and France with the same value that it has in Euskal Herria, in this case a physical length of 49 g.ft.. Once again this underlines the wide geographic diffusion of the septarian system. In Euskal Herria, however, there is reason to believe that the knotted cord along with the device employed to transport it from one place to another was commonly used on land, not just at sea. Finally, even though the earliest documentation for the "chip-log" does not surface until the appearance of William Bourne's work *Regiment for the Sea*, published in 1574 , the gorapila unit is already mentioned in a Basque law code dating from 1484, where instructions are given with respect to laying out the standard stone octagon (Alvarez et al., 1991).

In short, it would seem that the gorapila "knot" unit of measurement was utilized both on land and at sea by the Basques.[17] However, how far back in time this custom goes is still open to debate. Nonetheless, the stability across time in the architectural design of the standard stone octagon along with the relatively early Carbon-14 dating of some of the sites suggests that the unit of measurement itself reaches back at least to the Middle Ages, if not even significantly earlier. What exactly this means in terms of setting a date for the first appearance of the device used to estimate the speed of a craft is an open question. Finally, there is little doubt that the gorapila cord was transported from one location to another to lay out the stone octagons and consequently it is quite likely that the knotted device utilized in this task differed little from the one used by Basques in navigation.

2.2.6 Gorapila units, wind-rose and the "traverse board"

In this section we will look more closely at the way three elements worked together, interacting to achieve a reading of the vessel's speed and direction: the gorapila "knot" unit, the "compass-rose" and a device called the "traverse board". As was indicated in the previously discussion, there is reason to believe that the unit of measurement called the gorapila "knot" was not limited to the construction of the stone octagons, but rather had other applications, among them maritime usages. In order to understand how these three items interacted, we need to keep in mind that the septarian units discussed in this document

[17] Given the well attested exploits of Basque whalers—dating back to the ninth century—as well as the recognized skills of their ship pilots, e.g. Juan de la Cosa who sailed with Columbus and later with Americo Vespucci, and Juan Sebastian Elcano, whose ship was the first to circumnavigate the globe, we might even speculate that knowledge of the device passed from them into the hands of European navigators as some point in time (Doyaga, 1990; Kurlansky, 1999).

formed part of a more complex system that included the Basque septarian league, used on land and at sea (Frank, 1999a, 2008c). For our discussion, suffice it to say that the septarian league is well documented and was still being used by Basques in the 17th century (Gastañeta Iturribalzaga, 1692; Poza, 1585). However, we do not know how far back in time this particular unit of measurement goes.

As will be explained, the geometrical design of the stone octagons set forth in the Basque law codes required the placement of eight stones on the perimeter of the figure, four at the cardinal positions and another four at the inter-cardinal positions, creating what might be viewed as an eight-point "compass-rose". At the same time that the gorapila unit was employed to lay out this type of compass-rose figure on the ground, we will see that it was integrated into a related set of maritime practices. These allowed for charting a ship's course, that is, its compass direction and speed. The device used to keep track of the information necessary for such dead reckoning navigation was called a "traverse board", a simple yet quite ingenious invention. The helmsman's traverse board is mentioned in 1528 as part of the "Navigator's Set of Necessary Instruments" (Turner, 1998: 35). It operated as a memory aid to easily record the speeds and directions sailed during a watch. Even an illiterate crew member could use the traverse board. In our discussion of it, the board will be described from the perspective of a chip log using traditional septarian gorapila units.

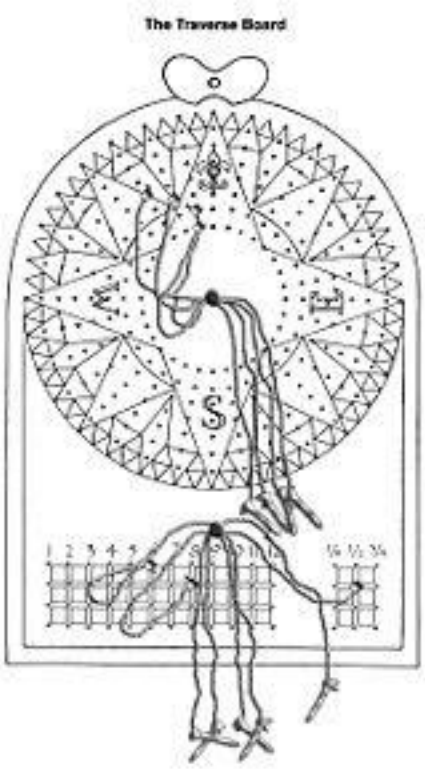

Fig. 10. Sketch of a traverse board. Source: http://en.wikipedia.org/wiki/Traverse_board.

First, we can look at the board itself and see how it might have been used by Basque pilots. The board regularly consisted of two parts: 1) a 32-point compass-rose with 8 concentric rings of holes incised in it: one ring for each 30-minute segment of a 4 hour watch; 2) eight 2-row groups of holes where the top row of each group of two would have been used to record whole "knots", i.e. 49 g.ft. units, while the second row would have been used to record fractions of "knots", i.e., 7 g.ft. *gizabete* units. And since there were 7 units of 7 g.ft. in each gorapila, six peg holes would have been needed to record the septarian fractions, while the seventh fraction would have been recorded as a whole "knot". During each half-hour period the chip log was used to measure the boat's speed. Then, if, for example, the cord registered 2 "knots" (gorapilas) and 3 seventh of a gorapila (3 gizabetes), a peg would have been inserted in slot 2 of the top row and another in slot 3 of the following row. This procedure continued during the entire watch, consisting of eight 30-minute segments. At the end of the first 30-minute watch, the heading of the vessel was marked on the compass-rose by inserting a peg in the first innermost concentric circle on the compass. This allowed the direction traveled during that period to be indicated on the board. Then, at the end of each 4-hour watch, the navigator would collect all the information about the speed and direction sailed which was recorded by means of the peg locations. After using the information obtained to chart the vessel's dead reckoning track, he would clear the pegs from the board. Meanwhile, at the helm the crewmember in charge of the next 4-hour watch would begin recording the sailing headings and speeds.

In practice the pegs were tied to cords which were attached to a keeper pin in the center of the compass rose and to another on the board below where the speed pegs were inserted. Unfortunately, the majority of drawings that purport to show how the traverse board operated are less than accurate in their portrayal of it. This is perhaps because of the significant confusion that often reigns among those who have attempted to unravel how the device functioned in actual practice. In *Fig. 10*, for example, the model allows for recording up to 12 "knots" of speed alongside a separate row where the fractions of a "knot" were recorded. This drawing shows four rows and assumes, apparently, a watch of four 1-hour segments, rather than eight 30-minute ones. Then the fractional pegs to the right of the board represent fractions of the entire length of the "knot", not individual septarian units, each of 7 g.ft., as would be the case with the Basque version.

Likewise, in these replicas of the traverse board it is not uncommon to see pegs inserted all over the compass rose, as if the vessel were going in one direction one minute and then suddenly veering off course and setting out in a totally different direction. Attempts to reproduce the way these devices might have been structured often are done showing regular placement of the pegs and frequently include details such as the color-coding that allegedly was employed at one point to distinguish cardinal points from inter-cardinal points, etc.. This can be seen in replicas such as the wooden traverse board with its compass rose and pegs created by the New Zealand artist Ann Verdcourt, currently on display at the Museum of New Zealand Te Papa Tongarewa

(http://collections.tepapa.govt.nz/objectdetails.aspx?oid=243759&coltype=art&regno=1996-0033-39/6/).

Historically, when the chip log was used in conjunction with the notion of a "nautical mile", i.e., defined as 1/60th of a degree of arc, its effectiveness depended on what the length of a nautical mile was thought to be at a particular time. Hence, from this vantage point, the greater the accuracy of the calculations of the Earth's circumference, the easier it would be to determine the proper length of the "knot" employed by the chip log.

> By 1756, the French Royal Academy of Sciences determined the nautical mile to be 6080 feet in length. A nautical mile being one minute of one degree of latitude (the distance varies slightly from place to place because the earth is not an exact sphere). For this distance, the space between the knotted cords on the log line, had to be 50 2/3 feet when using a 30 second glass, but some navigators used 48 feet and 28 seconds while others, who were very conservative, used 48 feet and 30 seconds. Prior to 1756, navigators and cartographers thought the nautical mile was as short as 5000 feet, very close to the statute mile. Today the nautical mile has been measured at 6077 feet at the equator, though it is generally rounded off to 200 yards for practical purposes. (McCleary, 2001: 3)

However, the Basque gorapila unit—along with its Spanish relatives, the *estado, braza, brazada* and even the French *brasse*—is based on what appears to be a different notional definition, one whose accuracy does not depend on the cord being divided into units that would give an accurate reading for 1/60th of one degree. By this I mean to say that the 49 g.ft. unit formed part of the earlier septarian coordinate system and, therefore, fed into calculations carried out, apparently, using septarian leagues where 1° of meridional arc was assigned a value of 23 1/3 leagues or 400,000 g.ft., with each g.ft. being equivalent to .278m (Frank, 1999a, 1999b; Paucton, 1780: 166, 194). This gives a definition of 1° of meridional arc of 111.2km, very comparable to modern day determinations of it, e.g., the 1852m "nautical mile" with 60 of these "miles" per 1° gives 111.12km. In conclusion, the gorapila unit of measurement used in laying out the stone octagons forms part of a larger and more cognitively complex geodesic system in which keeping track of directionality and compass orientation was important.

The results of our examination of the evolution of the "nautical knot", understood as a material and cognitive artifact, suggest that it ultimately harkens back to a conceptual system in which septarian units were actively functioning. We have seen what happened when the unit was mapped onto different spatial and numeric frameworks, e.g., as was the case when the French *toise* and *brasse* units were reshaped into *6 pieds du roi* and a sexagesimal model. In this sense, the various understandings of the "knots" on the chip-log cord represent patterns of evolutionary descent that appear to have been vertically transmitted—from one generation to the next—and then there is evidence of another framework where horizontal transmissions took place, transmissions that emphasize the impact of changes resulting from across-group contacts, e.g., the adoption of a "knot" based on units of *6 pieds du roi* and eventually the emergence of a "knot" whose length was determined conceptually not by the length of the preexisting septarian units of measurement and their conversion into septarian "leagues", but rather by a notional

definition of 1/60° that in turn was based on modern agreements between various groups concerning the definition of the Earth's circumference. That definition of a "nautical mile" assigned 60 of these "miles" per degree and fit neatly into the sexagesimally-oriented system where decimality also played a major role.[18]

3.0 The cultural emplacement of the Basque *sarobe*

Evidence for the standard design of the *sarobe* is encountered in the law codes of Gipuzkoa. The legal records specify the design, construction and celestial orientation of stone pillars utilized to lay out the Basque stone octagons. When I speak of the expression "standard design" of the *sarobe*, the expression corresponds to a translation of the term *sel común* used in the Basque law codes, specifically where they define the way the geometric figure is to be measured and how the stones are to be laid out on the ground. In this paper my focus is on the architectural design and the specific set of measurements that are encoded into the legal documents in question. In other words, the focus is on exploring the geometry of the *sel común* and consequently the "standard design" of the *sarobe*. Although in the rest of Europe stone circle building was abandoned many millennia ago, in Euskal Herria the stone octagons survived as functioning pastoral entities into the late 20th century, although their ultimate origins are shrouded in mystery (Ormaechea Hernais & Zabala Uriarte, 1988: 408). The sites have been fundamental organizational and structural components within the cultural assemblage of the Basque shepherd collectives. Therefore, they reveal specific socio-cultural contextualizations that have connected them intimately to the social architecture of Basque shepherd society (Ott, 1981, 1995).

In summary, among the Basques the septarian system of measures was enmeshed in a complex network of social practices and beliefs rather than functioning merely at an instrumental level as is true in the case of the decimal metric system (Bazola, 1917 [1853]; Lasa, 1964). Hence, the metrological standard, geometry and the septarian number system should be understood as foundational elements within the Basque cultural assemblage, as tools for structuring and giving meaning to the relationships and modes of thought entrenched in the social architecture of the people in question. In short, to examine these features in isolation is to fail to recognize that number systems are cultural products.

3.1 The nature of the sarobe

The Basque stone octagons are directly linked to pastoral practices that can be traced back to AD 853 in the written record of the Iberian Peninsula (Caro Baroja, 1973: 180).[19]

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[18] This contrasts with the older septarian framework that assigned 70 septarian "miles" (set at 1/3 of a septarian league) to 1°. The septarian league was defined as 17,142 6/7 g. ft. with a g. mile being 5,714 2/7 g.ft. (400,000 g.ft. ÷ 70). Thus, the use of the gorapila knot merely gives the distance traveled over 1 hr. as 120 gorapila or 5880 g.ft.

[19] This is a document of two bishops, Serverino and Ariulfo, dealing with the donation of the goods of the monastery of Santa María del Hermo or Yermo, which reads: Et in territorio de Campo, braneas, pascuas,

Documentary and archaeological evidence from Euskal Herria demonstrates the slow evolution of the *sarobe*.[20] They appear to have been established initially as inhabited enclaves and clearings located inside communal woodlands and pastures. Over the course of several centuries these *sarobe*, which were exploited collectively by the community, often passed into private hands. This transition was particularly common in the case of *sarobe* located in the valley lowlands, since their situation made them more desirable for agricultural purposes (Arregi, 1980; Díaz de Durana & Larrea Rojas, 2002; Ormachea Hernais & Zabala Uriarte, 1988; Ugarte, 1976).[21]

Even though *sarobe* sites often are represented on maps in the form of a perfect circle, as will be demonstrated, there is strong evidence that in Gipuzkoa (if not in the entire

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quas vulgus dicit Seles invertrate ad illam Lamani…", cited in (Caro Baroja, 1973: 180), while the original source is Risco. In the appendix of the document the terms *branna* and *braña* are constantly encountered.

[20] Given the breadth of the topic, the present essay cannot pretend to cover all of the aspects of the *sarobe* phenomenon. For readers interested in obtaining additional information, I recommend that they access the remarkable set of illustrations, photos and maps that can be found at the web sites of Luix Mari Zaldua Etxabe for the province of Gipuzkoa (http://www.paisvasco.com/urnieta/seles.html) and that of Xabier Cabezón for the river valley of Leitzaran in the province of Gipuzkoa (http://www.leitzaran.net/seles/index.html). At his web site Cabezón provides information on the stone octagons of Gipuzkoa, specifically, from the zone of Leitzaran, a river that stretches from Leitza in Navarre, passing through Berastegi and Elduain and flowing into the river Oria at Andoain. The stone octagons of Orenzun and Txertoki are in the district of Elduain. Concretely, the northern limit of Txertoki is situated some 200m from the frontier with the adjoining district of Hernani (Ereñozu is Hernani). The Leitzaran valley is situated just to the south of the Montes Francos del Urumea (Hernani, Urnieta, Donostia). In the 18th century, Leitzaran was covered by thick forests that were regularly exploited for charcoal that, in turn, was used for smelting iron in the same zone.

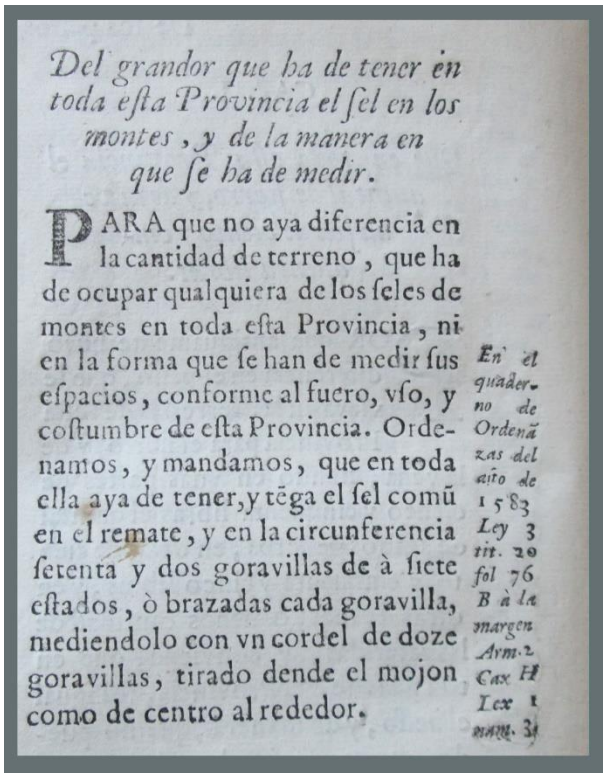
[21] Zabala, speaking of these structures in Bizkaia (Zabala, n.d.), provides the following concise summary of their use and evolution: "De hecho, si bien parece que los seles veraniegos, mientras fueron zonas ganaderas, eran espacios libres de pasto, los seles invernizos, cumplían otras funciones, incluida la de cobijo del ganado y así se indica en las Encartaciones, que muchos de ellos estaban cubiertos de bortos, o árboles bajos, que resguardaban al ganado de las inclemencias del invierno. A estos seles, también se les denomina *cortas*, *bordas* o *sarobes* y han dado según estas denominaciones lugar a abundantes topónimos que aún hoy pueden reconocerse, en sus diversas derivaciones, en casi todas las localidades vizcaínas. La mayor parte de los seles invernizos, los de las riberas de los ríos, fueron roturados en el siglo XVII, sustituyendo su primitivo destino de pastos, por el de tierras de cereal, en concreto, y mayoritariamente, de maíz; pero los seles menores, perduraron durante muchos años más llegando algunos de ellos a nuestros días, como pueden observarse en ciertas zonas montañosas, en concreto en la de Urkiola, donde todavía no hace muchos años llegaban a documentar cerca de una docena" ["In fact, while it seems that the summer octagons, while they continued to be used as zones for pastoral exploitation, were open areas used for pasture, the winter stone octagons fulfilled other functions, including providing shelter for the animals and as is indicated in the zone of Encartaciones, many of them were covered with *bortos*, or low trees that protected the animals from inclement winter weather. These stone octagons are also referred to as *cortas*, *bordas* or *sarobes* and, based on the distribution of these terms, have given rise to an abundance of toponyms that even today can be recognized in various derivations in almost all Bizkaian localities. The major part of the winter stone octagons, those in river bottom lands, were tilled in the 17th century, and their original purpose as pasture lands was replaced for that of cereal production, concretely, and above all, for corn; but the smaller [summer] stone octagons survived for many years, some of them even to today, as can be observed in certain mountainous zones, specifically in the zone of Urkiola, where still, not many years ago, around a dozen of them were documented."] (Zabala, n.d.). Other helpful works in this respect are those of Castro (2006) Belaustegi Aramendia et al. (2001) and Díaz de Durana (1998).

Basque region), conceptually speaking they were laid out in the shape of an irregular octagon. Their geometric design is well documented both in social practice and legal codes (Larramendi, 1745: 280). How the layout of this design was achieved on the ground is a point that will discussed in detail in the sections that follow. Moreover, as will be demonstrated, the octagonal nature of the geometric figure is implicit in the legal descriptions found in Basque law codes (e.g., *Cuadernos de Fueros de Guipúzcoa*, Tít. 20, Cáp. 2: 268, for the years 1583 and 1696 in *Recopilación de Leyes y Ordenanzas...* (Insausti, 1983 [1583]) and the *Nueva Recopilación* (S. Múgica, 1925).[22] In this respect the earliest known written record of instructions for the design of the *sarobe* is found in a law code from 1484, discovered and transcribed by researchers working on the manuscript collections housed in the Archivo General de Gipuzkoa in Tolosa (Alvarez et al., 1991).

The standard *sarobe* of Gipuzkoa was constructed with a total of nine stones: a center stone and eight stones on the perimeter, four of which were placed at each of the cardinal points, while the other four marked the inter-cardinal positions. Given that these structures had legal status, the way that they were to be laid out was specified in significant detail in Basque law codes. However, at the same time it is clear that those in charge of writing down the instructions, namely, the compilers of the law codes, did so by giving only the most basic information needed for assuring the proper design and dimensions of the sites, that is, without providing any detailed description concerning the geometric procedures that had to be used in their construction and the cognitive strategies that were necessary in order to bring about the desired results.

[22] In the law codes the expression *sel común* is the term used to refer to the standard stone octagon. Cf. also López de Zandegui and Cruzal (Insausti, 1983 [1583]).

We find essentially the same description over a period of some three hundred years in the *Fueros de Gipúzcoa* dating from 1484, 1583 and 1696, where it is stated that the standard unit of measurement for the radius of the figure was a 12 gorapila rope measuring 588 g.ft. (163.4m). Then the perimeter of the eight-sided figure is specified as measuring 72 gorapilas, that is, with 9 gorapila units between each outer stone. We also know that the center of the figure was marked by the placement of a stone called *haustarria* ("ash-stone") under which ashes along with pieces of clay tile were deposited. When the boundaries of the figure were re-inspected to make sure that no fraudulent placement of the perimeter stones had occurred, the practice of depositing ashes and clay fragments allowed the center stone to be distinguished from nearby natural stones. In addition much smaller *lekukoak* stones ("witness stones"), were placed near each center stone and upright which also aided in this process of identification (cf. Zaldua Etxabe, 2006, 2007).



Del grandor que ha de tener en toda eſta Provincia el ſel en los montes, y de la manera en que ſe ha de medir.

PARA que no aya diferencia en la cantidad de terreno, que ha de ocupar qualquiera de los ſeles de montes en toda eſta Provincia, ni en la forma que ſe han de medir ſus eſpacios, conforme al fuero, vſo, y coſtumbre de eſta Provincia. Ordenamos, y mandamos, que en toda ella aya de tener, y tẽga el ſel comũ en el remate, y en la circunferencia ſeſenta y dos goravillas de à ſiete eſtados, ò brazadas cada goravilla, mediendolo con vn cordel de doze goravillas, tirado dende el mojon como de centro al rededor.

En el quaderno de Ordenãzas del año de 1583 Ley 3 tit. 20 fol 76 B à la margen Arm. 2 Cax. H Lex 1 nam. 3

Fig. 11. Description of the dimensions and how the standard octagon was to be laid out. *Fueros de Gipúzcoa* (1583), Ley 3, Tit. 20. Source: http://berastegi-eta-inguruak.blogspot.com/2013/06/sarobeak-eta-selak.html.

In summary, the repetitive nature of the wording, across three centuries, in the legal descriptions dictating how the standard stone octagon was to be laid out makes it clear that the Spanish-speaking composers of the law codes were summarizing or simply repeating formulaic statements made by others before them. Furthermore, it is quite possible that the

compilers of this section of the law codes—codes written in Spanish, not Basque—were not familiar with the processes the Basques themselves employed when constructing the sites. In other words, those who were actually in charge of supervising the laying out the sites, following traditional methods of construction, appear to have been in possession of more knowledge and geometric expertise than the compilers of the law codes.

3.2 Design of the sites: Circles or irregular octagons?

At this point we can turn our attention to the question of whether the standard *sarobe* was designed to be a perfect circle, an octagon, or perhaps both. Again, I would emphasize that until recently the general assumption had been that the figure traced out by the placement of the eight outer stones was that of a circle, not an octagon. In order to resolve this question, we will begin by examining how the design of the standard *sarobe* (*sel común*) is described in Chapter II, Title 20, Law 3.a, of the *Cuaderno de Ordenanzas de Guipúzcoa* from the year 1583:

> Otrosí, conforme a las ordenanzas y al uso y costumbre que sobre ella había, dijeron que ordenaban, mandaban y establecían por la ley que en toda esta provincia de Guipúzcoa el sel común haya de tener y tenga en el remate y circunferencia setenta y dos gorabiles [sic] de a siete estados o brazadas cada gorabil [sic], midiéndolo con un cordel de doce gorabiles [sic] tirado desde el mojón como de centro al derredor. [Also, in accordance with the laws and customs that exist on this topic, they stated that they ordered, mandated and established by law that in all of this province of Gipuzkoa the *sel común* is to have and has in its *remate* and circumference 72 gorapilas, each gorapila being of seven *estados* or *brazadas*, measuring it [the radius] with a cord of 12 gorabilas stretched from the center stone to the perimeter]

From this description it is clear that one of the conditions for laying out the figure properly was the following: that the resulting perimeter of the figure should measure 72 gorapilas. This in turn demonstrates that the distance between each of the eight outer stones was set at 9 gorapilas.

Next we can examine Title 20, Law 3, of the *Cuaderno de Ordenanzas de Gipúzcoa* for the year 1696, composed a hundred years later. We find that it repeats the same instructions without specifying the number of stones or their orientation, e.g., without explicitly mentioning the need to place the outer stones so that they mark the cardinal and inter-cardinal points. What is noteworthy is this phrase: “[...] que el sel común haya de tener y tenga en el remate y en la circunferencia 72 goravillas [sic] a siete estados o brazadas cada goravilla, midiéndolo con un cordel de doce goravillas” [“The *sel común* is to have and has in its *remate* and its circumference 72 gorapilas, each gorapila being seven *estados* or *brazadas* in length, measuring it with a cord of twelve gorapilas”] (Larramendi, 1745: 280).

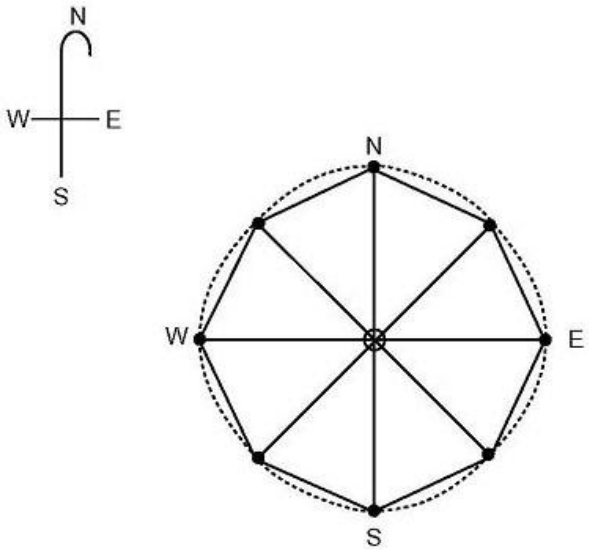


Fig.12. Alignment of cardinal and inter-cardinal stones and the central *haustarria* stone.

At first glance this discursive insistence on setting the perimeter of the figure at 72 gorapilas seems of little consequence. In fact, until recently this aspect of the descriptions found in the law codes did not elicit any particular interest on the part of Basque researchers (Frank, 2008c: 160-235). This is probably because investigators simply assumed the following, based on the already wide-spread knowledge of the dimensions of the standard *sarobe*: if the radius of the eight-sided figure was 12 gorapilas and its perimeter measured 72 gorapilas, this created a ratio between the perimeter and radius of 6:1, and this result was not anything remarkable. Generally speaking, it was assumed that since the law codes repeatedly expressed the dimensions of the figure by explicitly stipulating the straight-line distance around the perimeter of the figure and its radius, it was a regular octagon and this proportion was achieved merely by stretching the 12 gorapila cord from the center stone to the perimeter where each of the eight outer stones was then put in place. In short, centuries passed and no one challenged the assumption that the figure was a regular octagon, at least not until the spring of 1991.

The story is worth telling. I began investigating these stone configurations back in the 1980s. By the early 1990s the fieldwork that I had carried out was summarized in a draft document which I gave to a colleague at the University of Iowa where I was teaching at the time. The colleague was Dr. James Van Allen, a well-known astronomer and discoverer of the Van Allen Belts. A few days after I gave him a copy of the draft article, he asked me to stop by his office. Together we began discussing the material I had given him. At one point he paused and said: “I do have one problem with what you have written. In your

discussion you have included a drawing that implies that the ratio of 72:12 represents a regular eight-sided figure. I think you have missed something."[23]

He went on to explain the reason for his concern, namely, that the only figure whose perimeter has a 6:1 ratio with its radius is a six-sided one, a regular hexagon. Therefore, an eight-sided figure that has this ratio is an irregular octagon, not a perfect octagon. Consequently, what I needed to discover, according to Dr. Van Allen, were the factors that originally led the individuals in charge of designing the sites to choose an architectural design that created an irregular octagon. Did they want to achieve a 72 gorapila perimeter? And if so, what was their motivation? Did the choice of a 72 gorapila perimeter have something to do with facilitating the placement of the stones properly along the periphery of the figure? Or was something else going on that we still can't capture.

It is clear that those in charge of developing the original design of the sites were concerned—for reasons not yet clear—with orienting them in space. Thus, even without access to written texts we can determine that this concern was central to the thought processes that were brought to bear when the architectural design of the sites was being developed. Namely, we can assume that the builders deliberately chose to incorporate the cardinal and inter-cardinal positions into their design. Moreover, extensive fieldwork carried out on the sites has revealed that in this respect the positioning of the stones is quite accurate with deviations amounting to only one or two degrees from north (Zaldua Etxabe, 1996, 1997, 2006). Thus, the concern reflected by oral tradition and extant written documents about the importance of marking the cardinal and inter-cardinal positions was translated into actual practice.

[23] The meeting with Dr. James Van Allen took place on May 21, 1991.

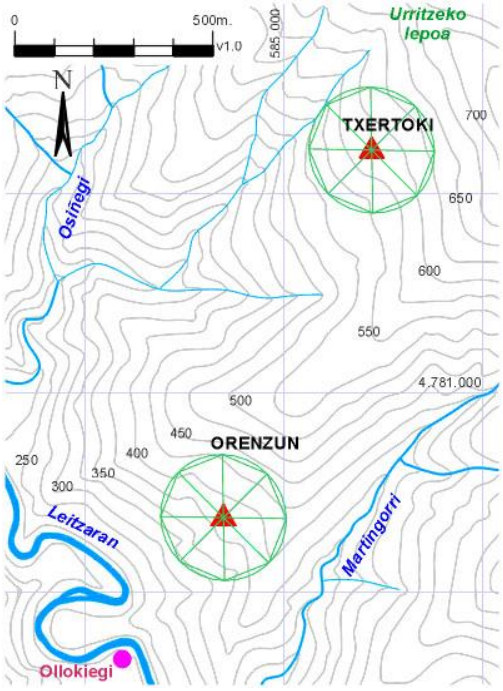


Fig. 13. Map of the *sarobe* of Txertoki and Orenzun (Bizkaia). Source: Cabezón: http://www.leitzaran.net/seles/orenzun.htm.

In theory, after the stone octagon was constructed, the cardinal and inter-cardinal positions on the landscape could have been identified visually merely by looking in the direction of the eight outer uprights. Yet there is no clear reason for the space to be oriented in this manner. For instance, did they—for some still unknown purpose—want to construct a compass-rose, a figure that would have allowed for other types of celestial measurements, e.g., by building into the architectural design the ability to have lines of sight to the horizon and then the ability to measure and mark the location in question using a gorapila cord stretched along straight lines between each of the outer stones? This, however, assumes that there was always a clear line of sight to the horizon. Or were there other reasons that are not apparent to us today? Some other set of socio-cultural needs? Moreover, in times past it is not likely that there was always a clear line of sight to the horizon since the structures often represented clearings in densely wooded areas.

At this point the answers to these quite provocative questions remain unclear. What can be determined is that the architectural design of the sites required their builders to interact with the landscape in the sense that the cardinal and inter-cardinal directions were integrated into the construction of the sites. These are elements that clearly do not respond to the needs of the animals, activities such as tending sheep and cheese-making. Rather they appear to be symbolic components of what seems to be a mathematically constructed model of space, one that allowed the shepherds to orient themselves with respect to the surrounding landscape as well as to the sky above. In summary, the design of the sites allows us to explore, albeit hypothetically, the conceptual processes of those who originally

came up with the celestially-oriented model itself and to ask whether it responded in some fashion to other concerns, other socio-cultural or cosmological necessities that the designers had in mind but that are not obvious to us today.

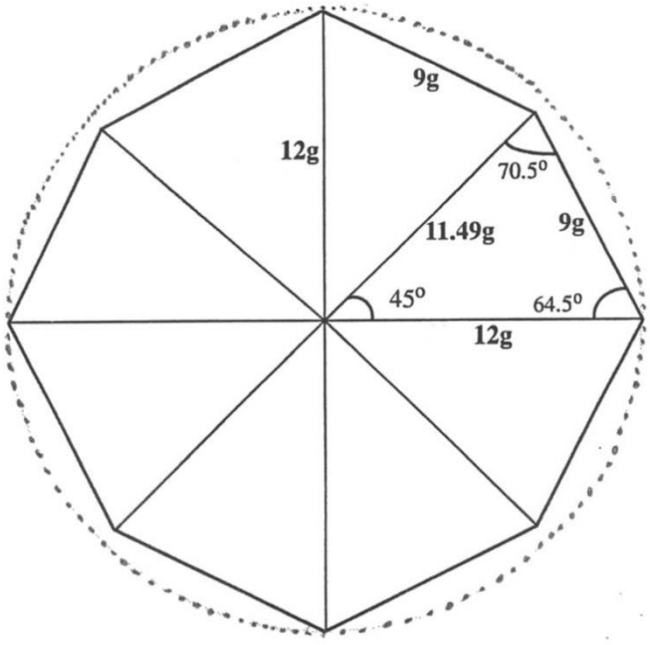


Fig. 14. Diagram showing the actual geometric design of the *sarobe*.

In other words, with respect to the geometry embedded in the figure, the designers intentionally altered the length of the radii extending from the center stone to the four inter-cardinal stones for, as is well known, according to the rules of geometry only a six-sided figure has a ratio of 6:1 between its perimeter and radius. This very important aspect of the geometric design of the *sarobe* was first pointed to me by Dr. James Van Allen back in 1991.

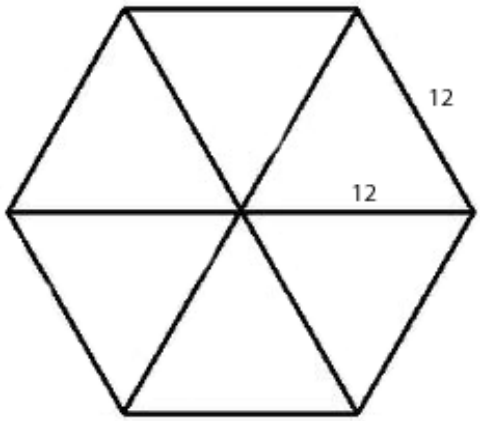


Fig. 15. Diagram of a six-sided figure.

Stated differently, rather than placing each of the eight outer stones at the same distance from the center stone, that is, using the 12 gorapila cord, they appear to have

placed the four cardinal stones first, using the 12 gorapila cord, and then the four inter-cardinal stones were placed, so that each of them was at 9 gorapilas from the other. To do this, the following strategy might have been used: one person would take a 9 gorapila length of the cord and stretch it from one of the cardinal stones; then another person would have taken another cord of equal length, marked off at 9 gorapila, stretching it from the next cardinal stone, adjacent to it. The point at which the two cords intersected was where the inter-cardinal stone would be positioned.

In short, the fact that this is an irregular octagon allows us model the geometrical procedures that might have been employed in the construction of the site. And, this process in turn shows that there is significant knowledge of geometry "frozen" or "preserved" in the construction of the figure (Gerdes, 1997). Additionally, the interrelationships holding between the geometry embedded in the stone octagons and the Basque septarian system of coordinates needs to be kept in mind: the septarian units fit into a larger, more comprehensive set of metrological practices as well as belonging to a cognitively astute coordinate system used for celestial and terrestrial navigation (Frank, 1999a, 1999b). And finally it should be recognized that the cognitive strategies and techniques possessed by those who laid out the figure are still not fully understood. However, they do seem to have involved the utilization of pegs, a long cord, and, initially, a method for determining the four cardinal directions and associated right angles.

Moreover, it is clear that the builders of the sites possessed technical knowledge and skills that are quite incomprehensible to us today. In this respect we should keep in mind the consternation expressed by Zaldua Etxabe who has carefully surveyed a large number of these sites:

> In fact, even today we do not understand how the builders of the stone octagons were able to bring about such accuracy in the alignments holding between the center stone and stones on the periphery, given that in many cases the vegetation (woodland) and orography (irregular relief, steep slopes) make it impossible for us to replicate their measurements when we attempt to carry out this task in situ, provided that, obviously, no use is made of compasses, G.P.S., etc. (Zaldua Etxabe, 2006: 113)

The geometry of the sites suggests that those who originally invented the architectural design itself were concerned—for some reason—with creating a perimeter consisting of whole units of *gorapila*. Furthermore, the care that was taken to produce this whole-unit circumference brings into focus another question: why were they so concerned with creating a celestially-oriented circumference consisting of whole units. What was their purpose in doing so? Previously, writers who portrayed the way that a *sarobe* was laid out failed to recognize this anomaly in its geometry, namely, that the stone configurations were not regular octagons. Rather than recognizing the mathematical impossibility embodied in the instructions found in the law codes, investigators simply assumed that a perimeter of 72 gorapila produced a perfect octagon in which the distance from the center stone *haustarria* to all eight of the perimeter stones was 12 gorapila, rather than the fact that the 12 gorapila radius was only the distance from the center stone to the four stones located at the cardinal points of the figure.

This misunderstanding of the legal documents becomes more apparent visually when we examine the following drawing which has been reproduced many times in the literature on this topic (*Fig. 15*). In this instance the person putting pen to paper was probably not an individual who had any direct experience in laying out the stone octagons. Another interpretation is the following: that by the time the modern diagram reproduced in *Fig. 15* was created those concerned with describing the shape of existing *sarobe* sites simply assumed—without proof—that all the radii of the figure were equidistant from the outer stones. And that assumption, albeit false, also made it appear that the geometry involved in laying out the architecture of the figure on the ground was limited to: 1) identifying the cardinal points; 2) stretching a 72 gorapila cord (588 g. ft. or 163.46m) from the center stone to each of the four cardinal stones and then; 3) repeating the same process in order to identify the proper location for the four inter-cardinal stones. That view, in turn, incorrectly assumed that such a construction process would automatically produce a distance of 9 gorapila between each of the outer stones.

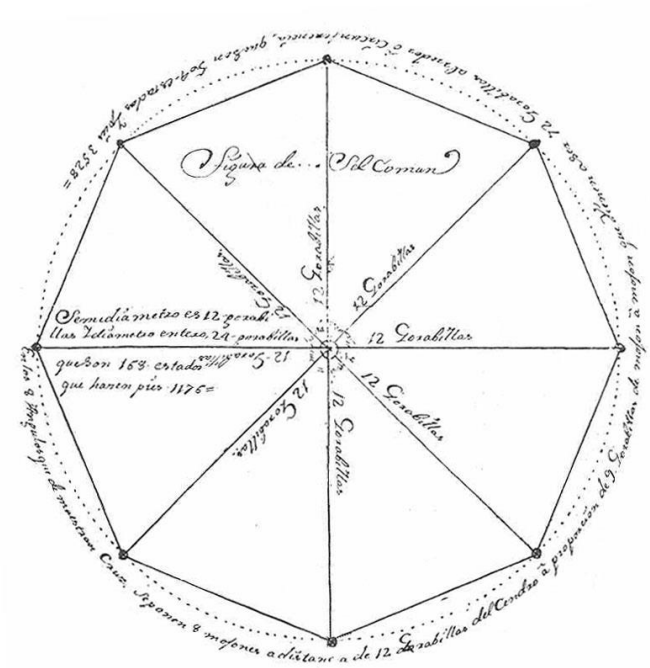


Fig. 16. Drawing of the Sarobe of Leitzaran (Sel Común de Leitzaran). Source: Garmendia Larrañaga (1976: 148).

In addition to the drawing above (*Fig. 16*) which dates from the early 20th century, more recent renditions of the standard dimensions of the *sarobe* (*Fig. 17*) also fail to recognize the geometric impossibility of an eight-sided figure having a ratio of 6:1 (72:12) (Ariznabarreta Zubero et al., 1998).[24]

[24] Another intriguing question for mathematicians resides in the fact that there is documentary evidence that the surface land area comprised by a *sarobe*—understood as a circular area—was divided into 'slices' consisting of multiples of 1/70. This septuagesimal method of division is associated concretely with the rights

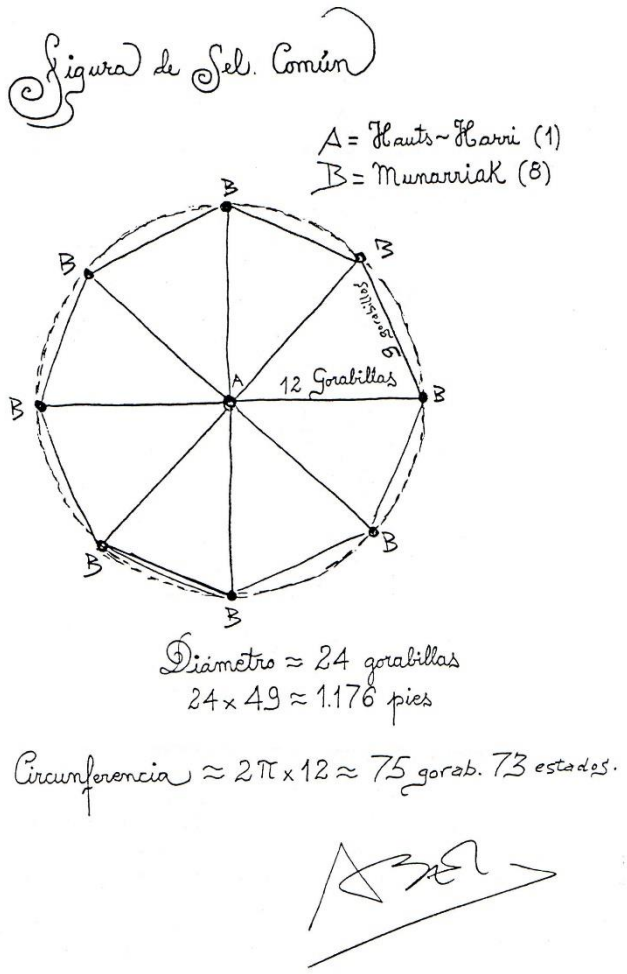


Fig. 17. Drawing of the *sarobe* (*sel común*) of Dima, Bizkaia. Source: Ariznabarreta Zubero (1994).

Returning to the standardized design and dimensions of the stone octagons, we often find that the top surface of the *haustarria* itself was employed to map the location of the perimeter stones. On the top of the *haustarria* a small center circle was frequently carved with eight radial lines pointing to the outer boundary stones. In one case, a cross-like figure indicating the four cardinal directions was incised into the flat rock face. The following examples demonstrate the variety of designs found on these stones.[25]

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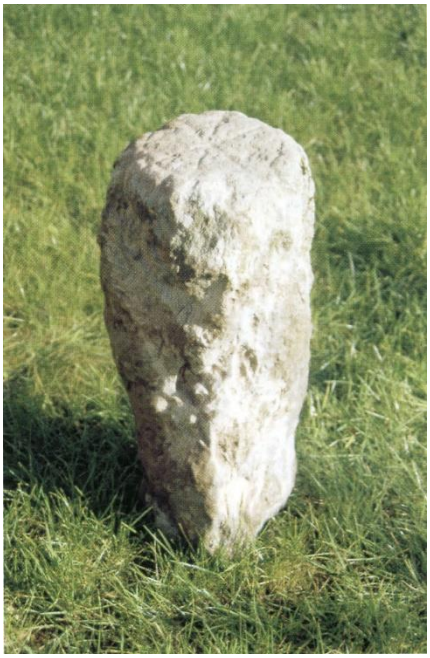
of the members of the collective to harvest the wood products from the *sarobe*. Nevertheless, the precise strategies employed to calculate these divisions is not entirely clear (cf. Ariznabarreta Zubero et al., 1998).

[25] In the case of the center stones shown here, there is every reason to believe that they are relatively modern and that in many instances they were located at the center of a pre-existing *sarobe*. In this way they replaced the pre-existing *haustarria* which, as Zaldua Etxabe (1996) has suggested, often consisted of a complex of stones with a single upright. The composite center stone excavated at Gorostarbe in Urnieta is an excellent example. For additional excellent photos of center stones, cf. http://www.iungonet.org/ELGG/luismarizald/files/ and http://www.iungonet.org/ELGG/luismarizald/weblog/archive/2007/05/



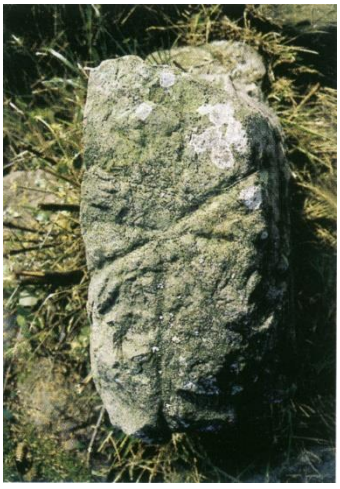


Fig. 18. Examples of *haustarria* center stones. Source: Zaldua Etxabe (1996: 36, 23, 110).

While this chapter has focused on the 8-stone figures, the standard octagon, the designs incised on the center stones documented by Zaldua Etxabe (2006: 156) are varied and even include examples of 16 points:

Often four smaller *lekukoak* or "witness" stones were placed in the ground immediately next to the *haustarria*, even though the exact configuration of these stones is not described in the law codes. From the sites we have examined, the actual practice varies greatly. At one location no witness stones were discovered while the center stone in question was a 1m high pillar with a 20cm square top. On this surface was the small center circle with its eight radial lines pointing to the eight boundary stones that were still in place. In another case local researchers discovered a *haustarria* with a broken piece nearby indicating an original height of more than 1m. They also found that four small stones had been packed about the base of one side of the center stone (Zaldua Exabe & Barrio, 1990). Other field evidence for the use of "witness" stones indicates they are found only on three sides of the base of the outer stones and that they were placed at some small but unspecified distance away from them. In documents from the end of the 17th century relating to land conflicts over the *sarobe* of the "community of blacksmiths" and the local town council, there is a set of instructions for correctly laying out the octagon. It includes the placement of four "witness" stones next to the *haustarria* as well as the placement of three "witness" stones next to each of the outer stones (Lecuona, 1959: 297-300).

The standard *sarobe* of Gipuzkoa which measures 12 gorapila in radius is understood to define the highland location of the pastoral collective during the summer months, whereas a sarobe of 24 gorapila in radius characterizes the lowland winter locations. Although this practice is common, in fact, in Gipuzkoa examples of the standard sarobe of 12 gorapila are frequently encountered next to or adjoining a double *sarobe* measuring 24 gorapila in radius. When viewed more broadly, taking into consideration the dimensions of *sarobe* in the other provinces of Euskal Herria, there is clear evidence that the *radii* of the stone octagons followed a strict sequential pattern of 9, 12, 18 and 24 gorapila, while within this sequence the 12 gorapila radius corresponds to the "standard" *sarobe* (or *sel común*) of Gipuzkoa. The cultural traditions that gave rise to the construction of *sarobes* with different sized radii (ranging from approximately 82m to 327m) are still unknown.[26]

4.0 The geographical extent of the sarobe

Although there is no comprehensive field study of the Basque stone octagons covering all seven of the Basque provinces, materials provided by researchers working in various parts of Euskal Herria give a general picture of the nature of the data (*Fig. 16*).

[26] For a discussion of the geographical distribution of these different cultural traditions, cf. Zaldua Etxabe (2006, 2007, 2008a, 2008b).

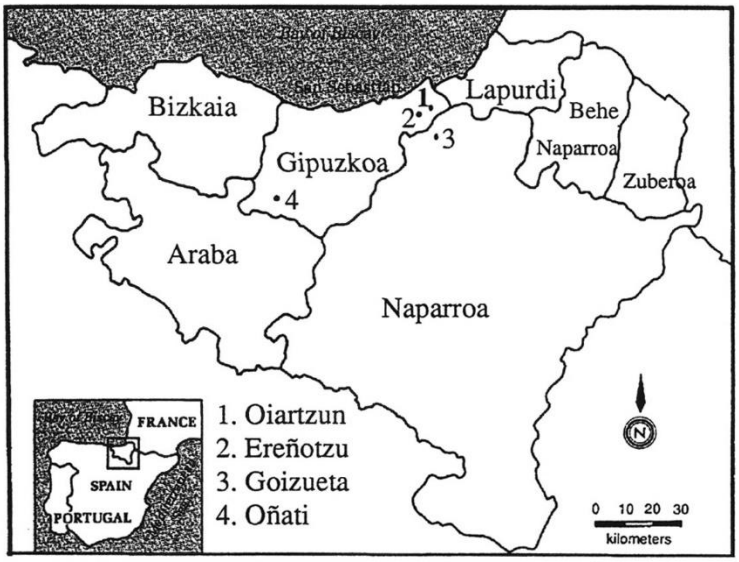


Fig. 19. Some of the sites studied in Euskal Herria for this study.

The study by Ugarte (1976) of the municipal district of Oñati which covers about 1502 km, produced a list of 28 sites still extant and 71 referenced in archival sources. A study of the plans of land titles of the same district revealed 39 potential sites. An extrapolation of these figures suggests the stones of at least a few hundred sites are still in existence and perhaps as many as five hundred or more sites can be identified in some way. For example, a map showing the *sarobe* of Goizueta, a district of Nafarroa covering about 1002 sq. km, provides significant information concerning the large number of sites that were still identifiable in that zone 130 years ago. Dating from 1863, the detailed map is itself a copy of an earlier 1792 map of the same zone. In addition to showing the location of each and every tree in the zone, it lists 113 *sarobe* by name and indicates that about eighty of them were still extant with their center stones in place. In the case of approximately thirty of the sites named and identified on the map, the stones could not be found at the time of the map survey. Local researchers working in the area in recent years have been able to identify only a few of the center stones of these sites.

In documents relating to a 1773 lawsuit found in the archives of the Real Chancellería de Valladolid, there are plans showing 22 *sarobe* in the Hernani district of the province of Gipuzkoa. Over the past decades, local researchers have managed to locate about half of these sites. While their original date of construction is unknown, the name of one of the 22 sites mentioned in the 1773 law suit can be traced back six centuries through documentary sources to the year 1189 (Zaldua Etxabe, 2006). In another case, a team of Basque researchers working in the municipal district of Oiartzun, Iñaki Arbelaitz, Jose Manuel Lekuona and Nicolas Etxebeste, spent many years conducting painstaking fieldwork along with an extensive review of toponymical data, without locating even one center stone. However, their efforts eventually paid off with the discovery of a very unusual *haustarria*.

Today teams of researchers continue to scour the Basque countryside with GPS in hand, fieldwork that has resulted in a remarkable number of new finds (Zaldua Etxabe, 2006).

The dangers to which the *sarobe* sites are exposed are exemplified by the experience of researchers who spent two years looking for the center stone of one site. They eventually came across it in a ditch where it had been left after being pushed aside by heavy equipment in a road-widening project. Hence, the *haustarria*'s original location could not be identified. This particular center stone was unique, being round with an outer circle around its rim as well as an inner circle along with the expected eight radial lines (Zaldua Exabe & Barrio, 1990). With respect to the overall state of repair of the sites visited, while a few are well preserved with all eight outer uprights and the center stone still in place, others have only their center stone intact. In many other cases few or no stones can be located even though the perimeter of the site is sometimes well demarcated by a fence, earthen wall or tree line.[27] In recent years far more work has been conducted on many of these sites. For example, in 2006, the leading Basque investigator, Luis Mari Zaldua Etxabe, came out with yet another remarkable book-length study, entitled *Saroiak eta Kortak*, which was followed by an in-depth study of other stone octagon sites in Legazpi, Bizkaia.[28]

4.1 The concept of *ebaki* in the design of stone octagons

There is another symbolic aspect to the construction of stone octagon complexes, symbolic in the sense that the element has no obvious practical purpose. I refer to the fosse dug around the sites which traditionally has been considered an integral part of their architectural design. According to some sources, the fosse is the most important part of the construction of a stone octagon in terms of setting it off from the rest of the space around it. Indeed, one informant alleged that stones were not absolutely needed, as long as a circular fosse was dug properly around the area in question. That, however, is a minority opinion.

When exploring the fosse and its significance, the Basque language itself provides us with significant information. In Euskara the terms used today in the various dialects of the language to refer to this ditch are *lubaki, luebaki* and *lubeki* which in turn are phonologically eroded compounds composed of *lur* “earth, ground” and *ebaki* “to cut”

[27] In recent years various groups of investigators have sought to bring more attention to the importance of these sites and their preservation to the appropriate authorities and the Basque public in general. In particular we should mention the research conducted by Luis Mari Zaldua Etxabe along with that of Abel Ariznabarreta Zubero, Kepa Velasco Irazabal, Zefe Ziarrusta Artabe, in Dima, Javi Castro in Deba, Xabier Cabezón in el Valle de Leitzaran and Manu Arregi in Oñati. In addition, field trips are regularly organized for the public so that sites themselves are visited during the outings.

[28] Both of Zaldua Etxabe’s recent works are available online at: http://www.saroiaketakortak.com/pdf/saroiaketakortak.pdf and http://www.euskonews.com/0457zbk/gaia45702eu.html#ref33 as well as two videos that provide additional visual information: http://www.euskonews.com/0457zbk/gaia45702eu.html#ref33 and http://www.youtube.com/watch?v=R5K5f50ebco. For an additional study of the *seles* of the zone of Abadiño by Aingeru Zabala, cf. http://www.bizkaia.net/Kultura/Ondarea_Bizkaia/pdf/ondare/37%20c.pdf.

(Azkue, [1906] 1969, I, 556). This produces a compound expression whose literal meaning is "earth-cutting" and, understood more generally as "trench, fosse". In the Middle Ages and beyond the process of cutting turf for the construction of the fosse of a stone octagon appears to have conferred a special significance—a kind of symbolic meaning or frame—to the site itself. This was because of the fact that there was a usufruct regime governing the usage of common lands. These lands could be converted into stone octagons or appropriated for agricultural uses only after obtaining authorization from the relevant authorities (Arregi, 1980: 601-656, esp. 643). As other researchers have pointed out (Ayerbe, 1986-87; Ott, 1981, 1995), the temporary appropriation of lowland communal lands for agricultural purposes and for planting orchards was more common since these lands were more suited for agricultural purposes than the highland, mountain pasturelands. In short, the usufruct regime gave to the members of each collective certain rights over the communal lands: the rights of use, but not private ownership. In the same way, under this regime of usufruct, the sheep of the households forming part of a given stone octagon community had free access to the communal pasturelands.

Once permission was given for the appropriation of a piece of common land, those involved could proceed to the next step which was a type of exteriorization of the authorization: the act of *lur-ebaki*. Recalling that earlier the turf was cut open, not with plows, but by hand-held tools, often with a relatively primitive two-pronged instrument called *laia* in Basque, the process was, indeed, labor intensive. Moreover, the right of usufruct to the land in question was governed by continued usage; abandonment of the land during a given period of time, usually one year, meant that that those who had gained the rights of usage would lose them.[29] In this way, the construction of a trench that opened up a given stretch of land was, in a certain fashion, an "act of possession" or at a minimum an "act of appropriation" of the communal resources.

[29] Writing in 1980, Arregi points out the following concerning the usufruct regime that governed the stone octagon enclosures: "El pastor, además, se mueve en un modo de vida donde no prevalece la propiedad privada, ni en los pastos, ni siquiera en el albergue o *txabola* que le sirve de habitación. Una prueba de esto es que hasta hace pocos años no podía cubrir con teja la *txabola* (Urbia, Urbasa, Andia, Aralar, Gorbeia…). Perdía el derecho a utilizar su *saroi* o majada, si dejaba pasar un año sin haber estado en ella al menos durante un día al año, con un rebaño o un carnero. [The shepherd, in addition, enjoys a mode of life where private property was not prevalent, not with respect to pasturelands nor even the living quarters or *txabola* that served as his home. A proof of this is that until a few years ago no one could cover [the roof of] the *txabola* with clay tile (e.g. in Urbia, Urbasa, Andia, Aralar, Gorbeia…). He lost the right to utilize the stone octagon if he let a year pass without having been in it at least during one day each year, with a flock of sheep or a ram.] (Arregi, 1980: 603). In this discussion, it should be noted that the presence of clay tile on the roof stands symbolically for private property. Likewise, it would follow that depositing ashes and fragments of clay tile at the base of the *haustarria* was a way of indicating that the latter should not be confused with a naturally occurring stone. Also, the deposit would have served to indicate a type of possession in usufruct of the territory in question, although not necessarily the notion of private property.

4.2 The Ereñotzu sites

One of the best-preserved clustering of sites is located in the hills above Ereñotzu in the district of Hernani, about 10km south of Donostia. This zone constitutes the primary study area for our discussion (*Fig. 20*).

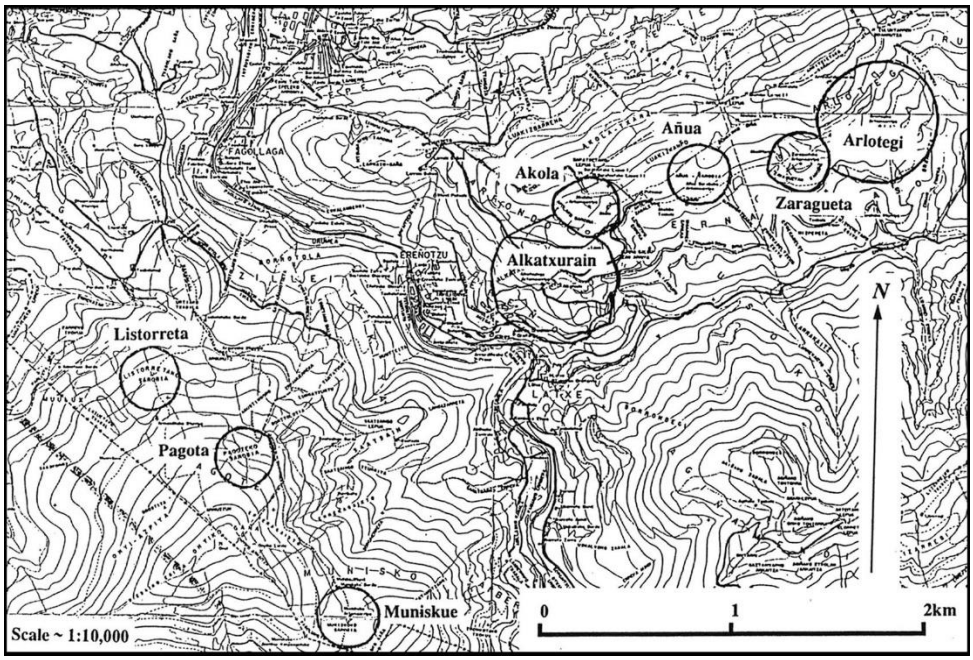


Fig. 20. Diagram of the Ereñotzu sites.

These sites are instructional for a number of reasons. First, all eight sites shown on the plan are still known by their original names: Listorreta, Pagota, Muniskue (Mulisko), Alkatxurain, Akola, Añua, Zaragueta and Arlotegi. The traditional practice of naming each octagon facilitates the identification of many other sites on the basis of local toponyms (Lekuona, 1989; Ormachea Hernais & Zabala Uriarte, 1988) since the term *sarobe* is appended to the name, as is the case of the above sites, e.g., *Listorretako Sarobe*, the "Sarobe of Listorreta". In this municipal district it is clear from the toponymic record alone that at least twice as many locations once existed. Through recourse to medieval documents and law suits we have references to the existence of a total of 38 *sarobe* sites, including the eight mentioned above, which can be dated back to the Middle Ages (Ayerbe, 1986-87). This fact indicates that the Ereñotzu sites themselves must have been constructed even earlier.[30]

Second, as the plans show (*Fig. 20*), the sites are often represented as circles and not as octagons demonstrating that an awareness of their original geometry is not a factor in the mind of the modern mapmaker and that the land area comprised by the sites was understood to be circular. Additionally, some sites show boundary perturbations, either

[30] For recent updates on the sites that have been identified cf. Zaldua Etxabe (2006).

disjoint boundaries, e.g., the southwest corner of the Alkatxurain *sarobe*, or a pronounced oval shape as is the case of the Akola *sarobe*. Furthermore, the complex reveals that sites can overlap each other, a factor for which no explanation has been forthcoming, although one possibility is that the overlapping sites are not contemporaneous.

Also, large and small *sarobe*, i.e., those of 24 *gorapila* and 12 *gorapila* in radius, can be found in the same locality and at the same altitude, a phenomenon encountered as well in other parts of Euskal Herria (Aragón Ruano, 2006). Previously, the reason given for the existence of these two different-sized *sarobe* was that they marked the summer and winter habitats of the shepherds and their livestock. The dimensions of the smaller *sarobe* were explained by saying that they corresponded to the needs of the sheep: the small *sarobe* were said to be located in the highlands and used only during the summer months. The dimensions of the large *sarobe* were said to correspond to the size needed by the flock during the winter months in the lowland pastures (Iturriza, [1775] 1884). And, indeed, this spatial division is well documented. However, the fact that both types of *sarobe* are found together in the highlands, at the same altitude and adjoining each other, suggests that this traditional manner of determining the size of the two types of *sarobe* was not always observed.[31]

What we cannot determine, based on evidence currently available, is whether in times past the large winter and small summer sarobe were always located at different altitudes or if exceptions were made. Perhaps earlier the climate was more conducive to keeping sheep during the winter months at highland locations. Or it could be that the changing nature of way the lands found in the valleys were exploited might have played a role, causing a scarcity of appropriate sites that in turn encouraged a shift away from using such lowland locations during the winter months. For instance, there is evidence relating to objections raised about sheltering the flocks in the lowlands in what were often rich river bottom lands, zones that over time were being taken over for agricultural purposes and/or more urbanized uses.

[31] Research by the Dima group has discussed the following fact: there are four sizes of stone octagons whose dimensions show a clear geometric sequencing of the radius of the figure: 9, 12 (*sel común*), 18 and 24 *gorapila*. According to this analysis, the radii of the Gipuzkoan sequence can be viewed as: 12 and 24; whereas those of the Bizkaian set would have been 9 and 18 (Ariznabarreta Zubero et al., 1998).

Fig. 21. Map of Los Montes Francos de Urumea (1773) showing distribution of small and large *sarobe*. The Ereñotzu sites shown previously (*Fig. 20*) appear here in the lower left-hand quadrant. Source: Zaldua Etxabe (1996). http://www.paisvasco.com/urnieta/seles.html.

Finally, six of the eight sites on the plan (Muniskue, Alkatxurain, Akola, Añua, Zaragueta and Arlotegi) are within 100m of either megalithic dolmens or cromlechs. In this respect, the Basque anthropologist José Miguel de Barandiaran was the first to stress the link between the distribution of megalithic structures and the practice of transhumance by the pastoral population of Euskal Herria. Indeed, the cromlechs and dolmens tend to be concentrated on cols, the ridges or plateaus that divide the watersheds of a mountain. These conditions also coincide with those characterizing the location of the summer stone octagon habitat areas of Euskal Herria.

In his writings, Barandiaran repeatedly noted that the areas occupied by pastoralists regularly have megalithic remains, whereas sites with conditions unfavorable to pastoralism have none (Bahn, 1983: 128; Barandiaran, 1973-1983, III, 445). Specifically, Barandiaran emphasized that the megaliths tend to be found where there is abundant pasture, good soil, a nearby water source, and favorable climatic conditions. These conditions also coincide with those characterizing the location of the summer stone octagon habitat areas of Euskal Herria.

> [...] no se hallan tales monumentos donde la naturaleza del subsuelo y las condiciones del clima no son favorables al establecimiento de majadas. [Such [megalithic] monuments are not found where the nature of the subsoil and climatic conditions are not favorable to the establishment of flocks.] (Barandiaran, 1953: 7)

In this respect, we should emphasize that stone octagons are often located on a southern facing slope, not a northern facing one, that is, the sites have a southern exposure and, consequently, receive maximum exposure from the sun. Moreover, Ugarte (1976: 452) who studied more than 60 stone octagons in the Oñate valley has reinforced Barandiaran's claims by pointing out that: "Podemos considerar como favorable, dentro del clima general, el microclima de la mayor parte de los seles." In other words, the majority of the summer stone octagon sites have a microclimate favorable to pastoral activities when compared to the climatic conditions of the zone in general.

Fig. 22. Photo of Asolamakio sarobe in Urnieta (Gipuzkoa). Source: Zaldua Etxabe (1996: 20).

Fig. 23. Photo of the Akola sarobe in Urnieta (Gipuzkoa). Source: Zaldua Etxabe (2014).

Barandiaran's conclusions have been reconfirmed by modern surveys of the sites carried out by Zaldua Etxabe (2006, 2008a, 2008b), whose findings incorporate greater statistical precision in regard to the data analyzed. In this respect Zaldua Etxabe (2006) has several remarkable advantages as a researcher. First, he is a native speaker of Basque. He is also a trained linguist and professional surveyor with substantial background in the field of archaeology. Therefore, the approach that he used to test Barandiaran's thesis is unique not only in the way that his multi-disciplinary skills have been combined and brought into play, but also because of the fact that his approach adds a new dimension to the research

model itself. By carefully charting the location of the stone octagons vis-à-vis the location of megalithic sites, this component adds a greater level of granularity to the research and subsequent analysis of the data. We are no longer merely talking in general about locations frequented by pastoral groups during the summer months, but rather about very concrete sites and their spatial relationship to megalithic monuments found in the very same vicinity.

In carrying out his investigations Zaldua Etxabe examined the distance between 70 megalithic sites and the summer stone octagons nearby. Bearing in mind the size of the standard stone octagon itself—it has a diameter of 327m (1176 g.ft.)—the results of his study are noteworthy:

> Orotara, 70 megalitoguneetatik saroietara dagoen distantziaren batez bestekoa 539 metroko da, baina 9 megalito alde batera utziz gero (12,85%) 412 metrora jaisten da zifra hori. Gehiago da: megalitoguneen %30 saroietatik 0-300 metro artean dago eta hainbateko hori bikoiztu egiten da aldea 500 metrora zabaltzean, megalitogune guztien %60 saroietatik alde hori baino gertuago baitaude. Guztiarekin, megalitoguneen 81% saroietatik 0-700 metrora dago. [Over all, the average distance between the 70 megalithic sites and the stone octagons [adjacent to them] is 539m, although after setting aside 9 megalithic sites (12.85%), the average goes down to 412m. Moreover: 30% of the megalithic sites are 0-300m from the stone octagons and that average doubles when the distance is increased to 500m, since 60% of all the megalithic sites are within that zone or closer. Taken all together, 81% of the megalithic sites are within 0-700m from the stone octagons.] (Zaldua Etxabe, 2008a)

This approach to viewing the landscape allows for further reinforcement of Barandiaran's hypothesis that pastoral groups were involved in the construction of some of these megalithic remains. That assumption is given further support by the results of carbon-14 datings of the sites.

5.0 Results and implications of Carbon-14 datings of center stones

In 1995, the first of eight attempts[32] to use Carbon-14 dating techniques to determine the time depths associated with the center stones was undertaken. More concretely, the excavation was carried by Agirre Mauleón and it involved dating the center stone of the *sarobe* called Gorostarbe, located in the common lands along the Urumea river belonging to the jurisdiction of Urnieta (Agirre Mauleón & Ibáñez Etxeberria, 1995). The results for the site were 1815 ± 60 BP. Stated differently, the ashes found under center stone dated the stone to between 120 to 240 AD. Hence, the ashes suggest that the geometric design of the *sarobe* was already firmly in place at that point in time.[33] Therefore it already formed part

[32] The sites in question where the excavations were carried out are: Gorostarbe (1995), Mendabio (1996), Altzusta (1997), Antxistagaraikoa (1998), Pikuetaondarra (2009), Intzensaroi (2009), Antxistaazpikoa (2009), and Uzkue (2011). Cf. Zaldua Etxabe (2014).

[33] One of the difficulties with such Carbon-14 dating techniques of the center stones is the following: in the past ritual inspections of the sites were often carried out to recheck the locations of the stones and when they were, the ashes and pieces of clay tile were replaced (Zaldua Etxabe, 1996). Given this custom, the dating of Gorostarbe to 1815 ± 60 BP, using the ashes at the base of the stone, could represent a false reading in reference to the point in time that the stone itself was first put in place. Undoubtedly, once additional *sarobe* sites are excavated and carbon-dated, we will have a better picture of the antiquity of the stone octagons and their possible relationship to the other pastoral practices that characterized the same zone.

of traditional pastoral practices at this early date. The fact that we can trace the design of the sites quite easily to the beginning of the Christian era also emphasizes the stability of their architectural design over nearly 2000 years. This suggests, although it does not prove, that the socio-cultural entrenchment of the design itself was significant. Consequently, it follows that we could assume that the Gorostarbe site was not unique, but rather that it exemplifies a lineage of material artifacts and cultural conceptualizations that would have reached back much further in time (Zaldua Etxabe, 2014).

Fig. 24. Close-up of top of Mendabio center stone. Source: Zaldua Etxabe (2014).

Of the eight attempts to achieve meaningful results, only three were successful, the first being that of Gorostarbe, discussed above. In 1996, the same team excavated the Mendabio center stone, not far from Gorostarbe. The Carbon-14 dating of the pieces of charcoal found under the base (Agirre Mauleón et al., 1996) gave a result of between the fourth and sixth century AD. However, it was the third result that is perhaps most significant. In 2009, an excavation was carried on Pikuetaondarra, in the mountain range of Aralar, under the direction of José Antonio Mujika, an archaeologist and professor at the University of the Basque Country (Agirre García et al., 2010). The charcoal remains encountered next to the center slab (*Fig. 24*) were dated to 2900 BP, that is, to the end of the Bronze Age.

Fig. 25. Center stone of Pikuetaondarra. Source: Zaldua Etxabe (2014).

In sum, the range of dates that result from the excavations move us back through the Iron Age to the Late Bronze Age, assuming, and it is an assumption, that the center stones in question formed part of the same type of structures we have been describing, that is, that each of them represented the center location of a stone octagon and, hence, a location that would have been occupied year after year by members of the same shepherd collective. Furthermore, since the cromlech--stone circles—will become a central focus of our discussion, a few words are in order concerning their composition and and time depth. First of all, the circles formed by the stones tend to be quite small, most of them falling into the range of 3m to 9m in diameter although there are notable exceptions with diameters that reach 20m. The stones themselves tend to be small when compared to the tall uprights of other more northern zones of the Atlantic Façade even though, as will be shown, it is not unsual for a cromlech to include a tall standing stone, one that would be visible from a significant distance. With respect to their time depth those that have been excavated date from the middle of the Bronze Age to the end of the Iron Age. The circles tend to be situated on or near crests and, therefore, along routes that would have formed an integral part of the communication networks associated with the tranhumance of that period and even later. Stated differently, the location of cromlechs coincides closely with the locations where we find summer stone octagons. In short, both phenomena appear to be related to these earlier pastoral social practices.

Consequently, when examining Zaldua's statistical results concerning the possible linkage between the stone octagon sites and the megalithic structures often encountered nearby, we need to keep clearly in mind the fact that in Euskal Herria cromlechs were still being built into the Late Iron Age while we have the Carbon-14 dating of the Aralar site that takes us back to the Late Bronze Age. Hence, the time frame for both types of structures appears to overlap. In short, the assumption is that the shepherds who occupied the stone octagons might well have been involved in constructing the cromlech circles nearby. Hence, the activities carried out at the cromlech sites would have formed a regular part of pastoral socio-cultural practices and responded in some way to the needs of this particular collective. At present, 853 extant cromlechs have been identified in Euskal Herria. These include sites with and without uprights while the cromlechs themselves can be located alone or in groups. The range of architectural styles is quite varied, from mimimalist to the extravagant (*Fig. 26, 27, 28, 29, 30).*

Fig. 26. Cromlech of Añona. Arano, Navarre. Source: http://www.kultura.ejgv.euskadi.net/r46-7772/fr/contenidos/informacion/gipuzkoako_megalitoak/fr_12921/mairubaratzak.html.

Fig. 27. Cromlech of Kausoko Lepoa. Oiartzun. © Luis Millán. Source: http://bertan.gipuzkoakultura.net/img/20/grandes/181.jpg.

Fig. 28. Adiko Soro cromlech. Eugi. Source: http://www.kultura.ejgv.euskadi.net/r46-7772/fr/contenidos/informacion/gipuzkoako_megalitoak/fr_12921/images/megalitos_222.jpg.

Fig. 29. Eteneta cromlech and upright. Source: http://3.bp.blogspot.com/_8DvlYGky5gk/SXjIhnj6nMI/AAAAAAAAAAqk/s8vo6yvj44s/s1600-h/7.JPG.

Fig. 30. The Mendiluze cromlech, Araba. Source: http://cromlechpirenaico.blogspot.com/2008/10/caracteristicas-el-cromlech-pirenaico.html.

As can be seen from the following list of cromlech sites, compiled recently by Peñalver (2004: 227) as part of his remarkable and highly detailed study of 1104 cromlechs from throughout the Pyrenean zone, only twenty cromlechs have been excavated and dated, specifically with datings from the Late Bronze Age (1300 to 700 BC) and Iron Age (800 BC to 50 AD). And, of the total twenty, nearly a third (Meatse, Okabe 6, Errosate 3, Pittare, Millagate 4 and Sohandi 5) fall roughly within 500 years or less of the Gorostarbe date of 1815 ± 60 BP, while the rest date back further in time, to the Late Bronze Age. Perhaps even more important is the fact that the Late Bronze Age cromlechs overlap closely in time with the date assigned to the center stone of Pikuetaondarra excavated in the mountain range of Aralar, namely, 2900 BP. This suggests that the two phenomena were co-terminus.

Consequently, it is highly likely that the groups who were involved in laying out the stone octagons were also actively involved in the construction of the small stone circles located nearby. In other words, it is quite probable that the two entities were linked in same fashion in terms of the functions they fulfilled for the populations in question and that these functions were tied to the sociocultural needs of a herding community.

Table 1. Cromlech datings. Source: Peñalver Iribarren (2004: 227).

Name of excavation site	Carbon-14 dating
Meatse 8	2960±50 B.P.
Apatesaro 1	2780±90 B.P.
Apatesaro 5	2740±60 B.P.
Meatze 5	2730±100 B.P.
Millagate 5	2730±60 B.P.
Meatse 11	2705±75 B.P.
Errozate 2	2680±100 B.P.
Apatesaro 4	2670±90 B.P.
Hegieder 7	2650±50 B.P.
Errozate 4	2640±100 B.P.
Zaho 2	2640±90 B.P.
Mulisko Gaina	2630±90 B.P.
Bixustia	2600±100 B.P.
Apatesaro 1 bis	2590±90 B.P.
Meatse 2	2380±130 B.P.
Okabe 6	2370±100 B.P.
Errozate 3	2330±100 B.P.
Pittare	2240±90 B.P.
Millagate 4	2120±60 B.P.
Sohandi5	800±210 B.P.

Also, we see that the Mulisko Gaina megalithic group comes in at 2630 ± 90 BP (*Fig. 28, 29, 30, 31, 32*), while the stone octagon known as Muniskue (Mulisko), located on the slope below Mulisko Gaina, is first mentioned in an archive dating from 1516. The following is an orthophoto of the site with the outline of the corresponding stone octagon Muniskue (Mulisko) just to the lower left of Mulisko Gaina (cf. yellow flag). The active version of this Google Earth map is accessible at the blogspot below, along with other remarkable photos of the site.

Fig. 31. Mulisko Gaina. Source: http://menhiresyotraspiedras.blogspot.com/2007/12/mulisko-gaina.html.

At Mulisko Gaina we find four cromlechs, a double chamber, a monolith and two structures of undefined characteristics. The materials are sandstone and terrain conglomerates. The following photo by the experienced mountaineer Kepa Castro allows one to appreciate the complexity of the site and its privileged location within the landscape. Other remarkable photos on his website document a hiking expedition into this zone and are highly recommended for anyone who wants to better understand the overall lay of the terrain.

Fig. 32. Mulisko Gaina. © Kepa Castro. Source: http://kepacastro.blogspot.com/search?q=mulisko.

The biggest cromlech is 5.60m in diameter and is made up of 31 stones, among which there is one that measures one and a half meters high. Another cromlech, 4.80m in diameter, includes 18 stones, two of which are also almost a meter and a half in height. The group also includes an isolated monolith that is similar in height to the other ones.

Fig. 33. Another view of Mulisko Gaina. Source : © Alonso Martínez. Source: http://www.megalithic.co.uk/modules.php?op=modload&name=a312&file=index&do=showpic&pid=4268..6.

Fig. 34. View from the opposite direction of Mulisko Gaina megalithic complex. © Alonso Martínez. Source: http://cromlechpirenaico.blogspot.com/.

Fig. 35. Mulisko Gaina from another perspective. Source : http://i15.photobucket.com/albums/a355/beltri_mendiak/Menhires/Adarra/MuliskoGaina03.jpg.

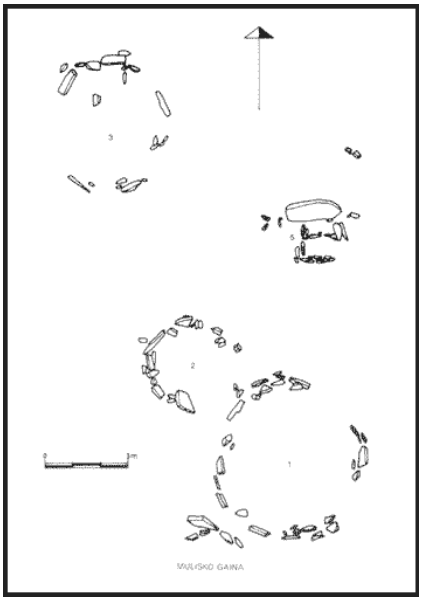
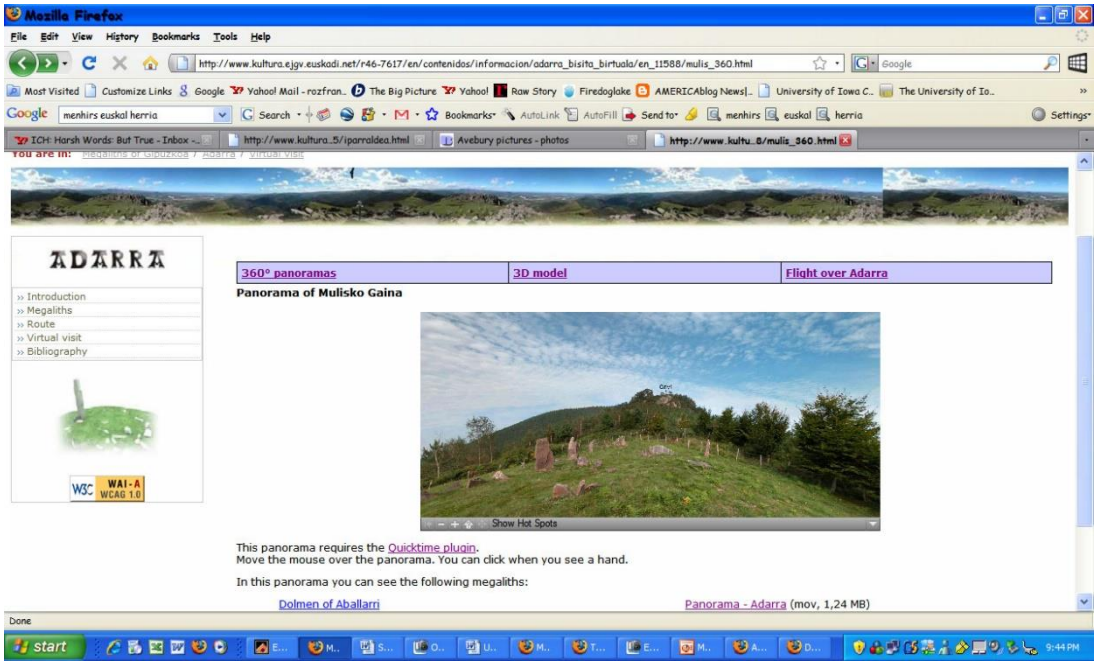
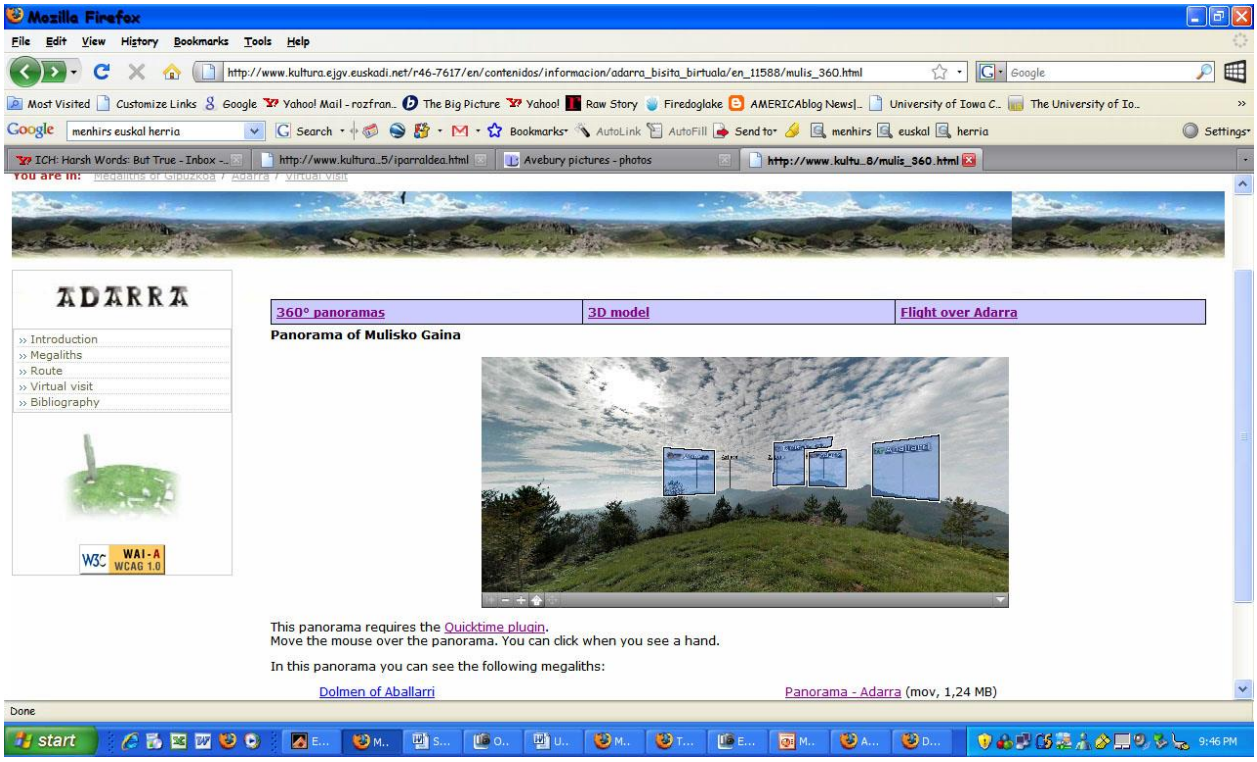


Fig. 36. Plan of Mulisko Gaina. Source: http://www.euskadi.net/r33-2288/eu/contenidos/informacion/adarra_megalitoak/es_11557/mulisko_gaina.html.

Virtual Panorama of Mulisko Gaina

Mulisko Gaina: 360° Interactive Internet Materials





Source: http://www.kultura.ejgv.euskadi.net/r46-7617/en/contenidos/informacion/adarra_bisita_birtuala/en_11588/iparralde_hegal.html.

In summary, the Mulisko Gaina site affords a clear example of the spatial relationship holding between the two types of entities, the stone octagon and the megalithic site nearby. The former tends to be situated on the slope below the crest whereas the megaliths are found higher up, near or on the crest, often with remarkable views of the surrounding

landscape. What has not been analyzed is the degree of intervisibility that existed between the sites, for instance, that is, how many other megalithic sites would have been visible from a given site such as Mulisko Gaina. As noted, many of the cromlechs found in these locations consist solely of a circle of low stones and hence would not have stood out in the landscape. However, fires lit in the center of such circle would have been perceived from a significant distance away and could have allowed for some type of communication between the various shepherd groups. Similarly, those sites which included tall uprights would have been easily identified from some distance away and served as landmarks. In short, the intervisibility of these sites has still to be researched.

6.0 The geographical distribution of cromlechs in the landscape

Speaking of the geographical distribution of cromlechs, called *harrespilak* and *mairubaratzak* in Euskara, Barandiaran makes the following observation:

> Por otra parte, estos monumentos se hallan en la misma zona axial del pastoreo estival y nunca en sitios donde no ha sido posible este género de vida. Por eso creemos que los constructores de los *espil* eran pastores y que la vida pastoral histórica y de los tiempos actuales se halla calcada en la que practicaban los pastores prehistóricos de nuestro país durante la edad del hierro. [On the other hand, these monuments are found in the same axial zone of summer pastoral practices and never in sites where this mode of subsistence has not been possible. Therefore, we believe that the builders of the *espil* [cromlechs] were shepherds and that the historically documented and present day pastoral way of life is reflected in the one practiced by the prehistoric shepherds of our country during the Iron Age.] (Barandiaran, 1973-1983, III, 445)

It should be recalled that the zones in which the stone octagon sites are found, have been occupied since time immemorial by Basque-speaking pastoral groups. Consequently, their transhumant mode of existence appears not to have undergone the linguistic and cultural rupture that has been associated with pastoralism in other parts of Europe. In other words, when analyzed from the perspective of the antiquity of the mode of subsistence associated with these sites, there was significant stability over several millennia. The environmental potential for exploitation of the highland zones changed only minimally. And, if anything, the pace of social change and technical innovation would have been significantly slower in the period from 2000 BC to 1 AD than from 1 AD to 1000 AD. In other words, there is no reason to assume a significant rupture in the social structure and economic base of the collectives occupying this zone during the Bronze Age or Iron Age. Likewise, there is no pressing reason to assume that the architectural design of the sites underwent major reorganization. Thus, the collocation of cromlechs and stone octagons suggests that a level of collective perception, shared cultural conceptualizations and a uniform system of measurement might have been existed during the Bronze Age or even earlier.

Furthermore, taking the palaeoeconomic argument a bit further, there is nothing that would keep the architectural design of the habitation sites from dating back to earlier relationships between the human collective and their herds of animals. The way of life of

the human collective is still largely dictated by the environment, and this situation must stretch back into prehistory, as Arambourou & Thibault (1968) have said:

> Des chasseurs de Duruthy aux pasteurs d'Oeyregave un même fil conducteur se retrouve : subie ou dirigée, c'est la migration saisonnière des troupeaux entre les pâturages de la montagne et ceux des plaines qui règle l'existence des uns comme des autres. [From the hunters of Duruthy to the shepherds of Oeyregave, the same organizational thread is found, namely, that it is the seasonal migration of the herds of animals—whether [they were being] pursued or driven—between mountain and plains pasturelands, that governs the existence of both [human groups]]. (Arambourou & Thibault, 1968)

In short, the seasonal movement of the herds did not always depend solely on the desires of their human keepers. Rather in this zone pastoralism evolved from the earlier ecological dynamics afforded by configuration of the landscape. Speaking of the culturally homogeneous nature of this zone, concretely, the one in which Palaeolithic cave paintings occur, i.e., mainly in the area of the Pyrenees, in Périgord, Toulouse (France) and Cantabrica (Spain), Wildgren has observed that:

> Probably the area was a very early economic "Kulturbund" (network of civilizations) in Europe. The herds of reindeer (as in northern Finland today) defined the relevant ecological dynamics. They probably came to the plains in winter and returned to higher grounds in the Pyrenees, the Cantabrica Mountains or the Central Massif in France in summer. The populations of Cro-Magnon men followed the herds and thus came into contact with other populations in southern France and northern Spain. This contact and common basis of survival would explain a common (or similar) system of beliefs, myths, and rituals […]. Consequently, these paintings are the result of a rather specific, although geographically large, "civilization" […]. (Wildgen, 2004: 65)

The question arises, therefore, whether a similar homogeneous way of life once characterized the same zone during the Bronze and Iron Ages, similar at least in the sense that the social collectives had a shared economic base, were dedicated to pastoral pursuits, developed a comparable design for setting out and orienting the space assigned to their habitation sites and perhaps even were bound by a shared septarian system of measurements.

Fig. 37. Orenzun (Bizkaia). Source: Diputación Foral de Gipuzkoa. Overflight of April-May 2001. Reproduced by Cabezón: http://www.leitzaran.net/seles/orenzun.htm.

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Fig. 38. Bizkaian sites in Dima. Source: http://www.iungonet.org/ELGG/luismarizald/files/-1/17/KortakDima.jpg.

At this stage in the research we have not examined the striking similarities holding between the septarian metrological practices abundantly documented in Euskal Herria and along the Atlantic coast (as well as some other parts of Europe), an investigation that is already nearing completion (Frank in prep.-e). Once the evidence is laid out, these commonalties will bring into focus the need for further study of the socio-cultural embeddedness of the metrological system under consideration here. Stated differently, as is well known, uniformity in metrological practices—the use of the same units of measurement and conceptual strategies—is frequently the result of long-term commercial and social exchanges between the collectives in question (Kula, 1980, 1986). In this regard, speaking of the notion of distributed cognition, Sharifian has argued that "[l]anguage is a central aspect of cultural cognition in that it serves as a 'collective memory bank' (Frank, 2003, 2005; wa Thiong'o, 1986) for cultural conceptualizations that have prevailed at different stages in the history of a speech community. Language may best be viewed as a primary mechanism, but surely not the only one, for storing and communicating cultural conceptualizations" (Sharifian, 2009: 165). Certainly a closely related mechanism for storing, communicating and transforming cultural conceptualizations into social practice consists of unified metrological traditions, such as the septarian system that has been documented in this chapter. In other words, it is highly likely that the widespread evidence for the use of septarian units of measure in this zone is associated with more elaborated metrological practices and conceptual strategies that for reasons not yet fully understood manipulated multiples of seven.

In sum, these considerations underline the possible importance of these septarian units, understood collectively as a traceable evolutionary lineage of cognitive artifacts. Moreover, they might have served as key components in cultural exchanges taking place over a wider geographic region of Europe (Frank, 2008a, 2008b, 2009, 2015). Likewise, we need to keep in mind the range of applications associated with the septarian units of measure discussed previously in this chapter, e.g., the gorapila 'nautical knot'; that they

are directly implicated not only in the architectural design of the Basque *sarobe*, but also in strategies and techniques used in navigation. Indeed, as has been documented elsewhere, the units of measurement, e.g., the geometric foot, are essential to a more complex metrological coordinate system used for celestial navigation on land and at sea prior to the establishment of the metric system in the 1800s (Frank, 1999a, 1999b, in prep.-b; Frank & Arregi Bengoa, 2001).

Viewed from this perspective, the stone octagon cultural complexes function as "material metaphors" that, once unpacked, reveal knowledge which otherwise would not be accessible to us. Rather than being explicitly or discursively expressed, the knowledge is embedded in the artifact and related social practices and transmitted in this manner across time through mechanisms typical of oral cultures. In this regard, we should keep in mind the fact that the Basque language did not develop a written tradition until the latter part of the 19th century and even then only a miniscule portion of Basque speakers were capable of reading in their own language. Indeed, wide-spread literacy in Euskara did not become widespread until the final decades of the 20th century when the establishment of the unified language standard, called Batua, was established and accompanied by massive literacy campaigns.[34] In conclusion, the septarian units of measure themselves, understood also as artifacts, represent a kind of cognitive residue, serving as evidence, albeit inferential, that a shared knowledge base once characterized a wider zone along the Atlantic facade. Hence, we are talking about a form of distributed cognition—shared cultural conceptualizatons—that must have been maintained through significant cultural contacts and exchanges over an extended period of time (Sharifian, 2008).

Until now investigations of Western European megalithic sites have concentrated on analyzing the disposition of archaeological remains and from those remains, researchers have attempted to determine to what extent the architectural design of megalithic sites incorporated celestial knowledge (e.g., astronomical alignments), expressed concepts of territoriality, social solidarity and/or mortuary symbolism. Any approach which focuses almost exclusively on the material remains assumes a particular model of prehistory for Western Europe. Embedded in that narrative we often find thefollowing argument: that because of the cultural and linguistic rupture brought about by the incursion of Indo-European speakers into the zone, no traces of the earlier indigenous cultural assemblages survive in the present-day practices and knowledge base of populations inhabiting areas where megalithic monuments are found. This position has been summarized by Ruggles:

> In some countries, archaeological studies benefit from evidence other than just the present disposition of archaeological remains: in Mesoamerica, for instance [...] there exists ethno-historic evidence (accounts by Spanish invaders of practices current when the sites were in use), ethnographic material which is clearly relevant (present-day practices by descendants of the groups

[34] There is little evidence of a tradition of writing in Euskara until relatively recently. Yet we need to keep in mind that in recent times Basque speakers were regularly schooled in French or Spanish and therefore tended to be literate in these languages, but apparently not in their native tongue.

> being studied) and first-hand accounts (Maya and Aztec codices). However, none of these other sources is available in British work. (Ruggles, 1984: 14)

In the case of the Basque Country these other sources are abundantly available. In this geographical zone, the transmission of cultural practices from generation to generation has taken place primarily in Euskara, a language that is recognized as being pre-Indo-European. Consequently, although at this time we cannot state that the architectural design of the stone octagons and their geometry date back to the Neolithic, there is significant evidence that there was significant continuity in the transhumant social praxis of this zone (Cavaillès, 1910; Thalamas Labandibar, 1935a, 1935b). In other words, there is reason to believe that the stone octagons belong to the ethnocultural substrate associated with the transhumant herding communities of this zone. Furthermore, the evidence points to a complex network of material and non-material cultural artefacts that have survived across several millennia, with the added advantage that in this zone there is no indication of cultural or linguistic rupture.

7.0 Astronomical considerations

The intricacy of the geometry of the *sarobe* leads us to believe its design could have held ritual significance for those who originally invented it. Moreover, the fact the sites are astronomically aligned to the eight directions sets up the real possibility that the sites were intended to be replicas of the cosmos itself, or at a minimum served as mechanisms by with the occupants of the stone octagons could orient themselves in space. Given that there is no record that the Basques never built temples in pre-Christian times, the attention paid to the orientation and the design of the sites calls out for an explanation: do the sites also embody cosmological beliefs and therefore reflect a concern with the location of the stars in the sky above? Again, the fact that the septarian units of measure fit into the cognitive framework of a more complex coordinate system makes this hypothesis an interesting one. Then, although it is unclear whether the sites themselves were ever used as observatories, there is the fact that they are sometimes called *begitokiak*, the same Basque term used to refer to modern day astronomical observatories. In short, whether the builders were consciously attempting to create a model of the cosmos remains unclear.

Nonetheless, we need to underline the sophistication of the technical skills and cognitive strategies employed by those who constructed the sites. As others have pointed out, the strict attention paid to orientating the boundary stones, the fact that the center stone is often incised so that it functions as a map in miniature of the site itself, as well as concern with setting out distances with remarkable precision, all leads to the conclusion that the design of the sites embodied the desire of its originators to orient themselves in space, within the landscape, perhaps taking into consideration the stars in the sky above. Indeed, investigators frequently have mentioned that the sites are laid out with precision, like a “compass-rose”.

However, as Zaldua Etxabe has shown, in times past achieving this level of accuracy would have been an extremely difficult task in a large part of the territory comprised by Euskal Herria, especially in the Atlantic versant which is made up of zones that are both heavily wooded and characterized by steep slopes. “In this respect, […] we are talking about an area characterized in ancient times by dense forest, since it was located within a territory commonly referred to by Roman historians and geographers as *saltus vasconum* (Zaldua Etxabe, 1997: 99). He concludes the following: “we can assert that under such conditions, namely, with dense woodland and irregular relief as complicating factors, how they managed to construct an octagon, often perfectly aligned astronomically, with only a cord and without recourse to modern technology, is still a mystery to us” (Zaldua Etxabe, 2006: 113). In conclusion, there are still many aspects of the architectural design and construction of the sites that are not fully understood.

Fig. 39. Wooded nature of Olaberriaga Sarobe. Source : Zaldua Etxabe (2006: 86).

Fig. 40. The cromlech of Etzelako Arritxurriak. Source : http://www.euskadi.net/r33-2288/eu/contenidos/informacion/adarra_megalitoak/eu_11557/etzela_arritxuri.html.

Fig. 41. The woodland of the Gorostarbe Sarobe. Woodland. Source: Zaldua Etxabe (2006: 86).

Even though evidence pointing to the earlier cosmological significance of the design of the sites is inferential, there is one strand that is solid: the connection between the septarian units of measurement used in the construction of the sites and the pre-decimal septarian coordinate system which was used by Basques for celestial and terrestrial navigation. In other words, while there is no direct evidence that those who inhabited the stone octagons or the cromlechs nearby were concerned with the night sky, there is proof that in times past Basques employed a highly sophisticated coordinate system, including a septarian league (Frank, 1999a, 1999b, 2008c, in prep.-b). That fact alone suggests that at some point they were intensely concerned with achieving a mathematical model of the cosmos. Moreover, as mentioned earlier, septarian units of measurement found in other zones of the Atlantic façade might well form part of the same knowledge base (Frank, in prep.-a). And if we were to take the logic of this argument a bit further, we would ask how we might determine the age of the septarian coordinate system itself.

At this juncture the time-depth of the system has been probed by means of Carbon–14 dating so we have a way to anchor it in the Iron Age or earlier. Other approaches to the extant data, drawn primarily from Greek astronomical texts, suggest that the septarian system could have been being used at an even earlier date (Frank, in prep.-b) and that it was perhaps pan-European in nature. Finally, one of the most provocative lines of research rests on the fact that the radius of the standard stone octagon (588 g.ft. x .278m = 163.5m; or using Zaldua's .28m value (Zaldua Etxabe, 2006: 112) for the g.ft., 588 g.ft. x .28m = 164.64m) coincides closely to the radius assigned to Avebury[35] by Thom (1967: 89-91), namely, 544 English feet (165.8 m.), although keeping in mind that the Avebury site itself is not a perfect circle.[36]

[35] If one goes to "Avebury" using Google Earth there are excellent photos available of the site.

[36] This topic is explored even futher in in the most recent contribution by Zaldua Etxabe (2006: 1-14) which can be viewed online: http://www.saroiaketakortak.com/pdf/saroiaketakortak.pdf.

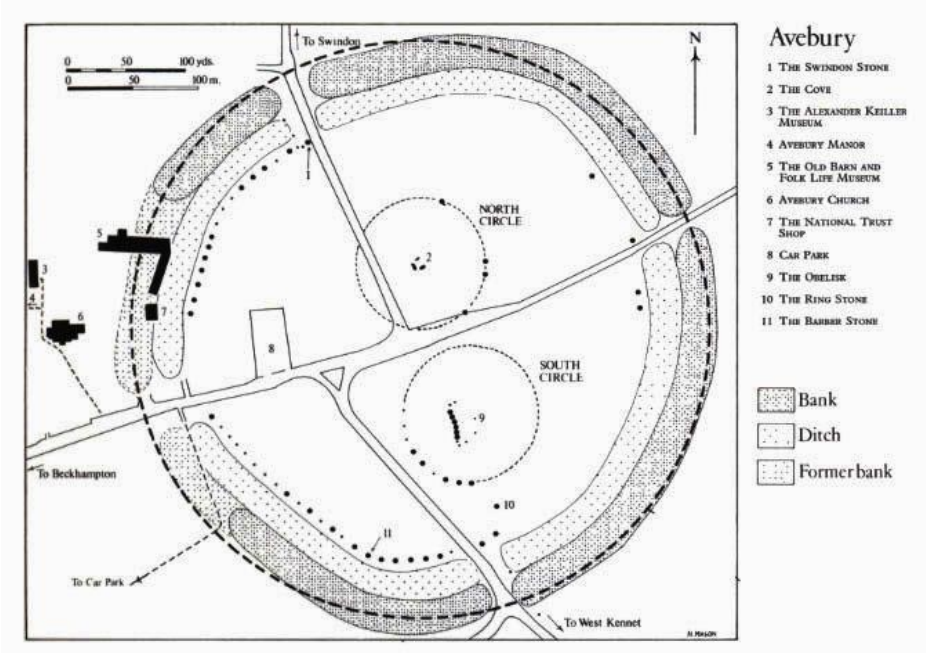

Fig. 42. A reproduction of a diagram of the Avebury site. Source: Zaldua Etxabe (1996: 82, 84).

Fig. 43. An aerial view of Avebury. Source: Zaldua Etxabe (1996: 84).

Fig. 44. A view of the fosse with the village of Avebury in the background. Source: http://www.bugbog.com/gallery/england_pictures/avebury-pictures.html.

Thom's calibration of the main ring of Avebury at 544 ft. was based on his belief that the builders were attempting to achieve a radius of precisely 200 Megalithic Yards, each of 2.72 English feet, a conclusion that also reflects certain assumptions about the cognitive processes of the builders: their favoring of decimality. Therefore, before leaving the topic of Avebury, this aspect of Alexander Thom's research needs to be addressed: his proposal concerning the origin of Megalithic Yard (MY) which he set at 2.72 English ft. or .834m. He reached this conclusion after surveying over 250 stone circles in England and Scotland and doing a statistical analysis of the results. Subsequently, his son continued the project and confirmed his father's earlier results.[37] This research was published originally in the *Journal of the Royal Statistical Society* in a paper entitled *A Statistical Examination of the Megalithic Sites in Britain* (Thom, 1955). While recognizing the controversial nature of the Megalithic Yard (MY) that the Thoms proposed, especially the pseudo-science extremes that to which the concept has been taken in recent years. Also, there is the well-known fact that many archaeoastronomers have questioned the accuracy of the surveys themselves.[38] Nonetheless, the unit itself is curious because of its correspondence to a

[37] Later Euan MacKie carried out a similar statistical analysis in Scotland, measuring the radius of hundreds of Iron Age forts called *brochs*, structures that are reminiscent of the round structures found in the Iberian Peninsula called *burches*. Moliner (1966, I, 1330) defines the term *burche* as a "torre de defense", i.e., a "defensive tower". According to MacKie, his surveys resulted in a bar standard of 2.74 imperial feet (.835m) (MacKie, 1977).

[38] It should be noted that more recently, based on new archaeological findings, Thom's work on the megalithic yard has been reevaluated in a more positive light. Paradoxically over the last few decades a variety of new evidence has been accumulating which implies that Thom's original propositions were basically on the right lines, and the more important of these discoveries will be described. The newest and most dramatic however is from archaeology itself –nothing less than from the first known stone temple precinct in northern Europe.

particular historically documented bar standard that in turn is linked to the septarian units discussed in this study.

According to Thom, the MY was the standard unit used by builders to lay out their stone circle sites, not just at Avebury but all across Britain. After determining that the unit measured 2.72 ft., he began to search for equivalent measuring rods. And it was at this point that he stumbled across the Spanish *vara*. In 1967, he wrote the following concerning this unit of measurement:

> It is one of the objects of this chapter to demonstrate unequivocally the existence of a common unit of length throughout Megalithic Britain and to show that a its value was accurately 2.72 ft. We might speculate that this unit was left in the Iberian Peninsula by Megalithic people to become the *vara* of recent times and to be taken to America by Spain. (Thom 1967: 34)

Some thirty years ago when I first came across this section of Thom's work, I decided to contact him in order to explain that the *vara* unit that he was discussing was linked directly to the official bar standard known as the *vara de Burgos* or *vara de Casilla* and set at .8358m, in contrast to Thom's MY of .834m. In my letter to him, which I wrote in 1977, I also pointed out that this unit was identical in length to the bar standards used in Gipuzkoa and Bizkaia. In his gracious response, he encouraged me to continue working on this avenue of research and explore the social practices associated with the unit. So, returning to Thom's assumption that the builders of Avebury had an architectural design in mind that set the radius at 200 MY (544 ft.), we could compare that hypothetical design of Avebury to the historically attested design of the standard stone octagon whose radius was set at 588 g.ft. or 196 bar units of 3 g.ft. each. Then following the same line of reasoning, the irregular shape of the Avebury main circle might be explained, at least in part, by the fact that they didn't intend the stones to lay out a perfect circle, but rather an irregular octagon. Naturally, this is pure speculation on my part.

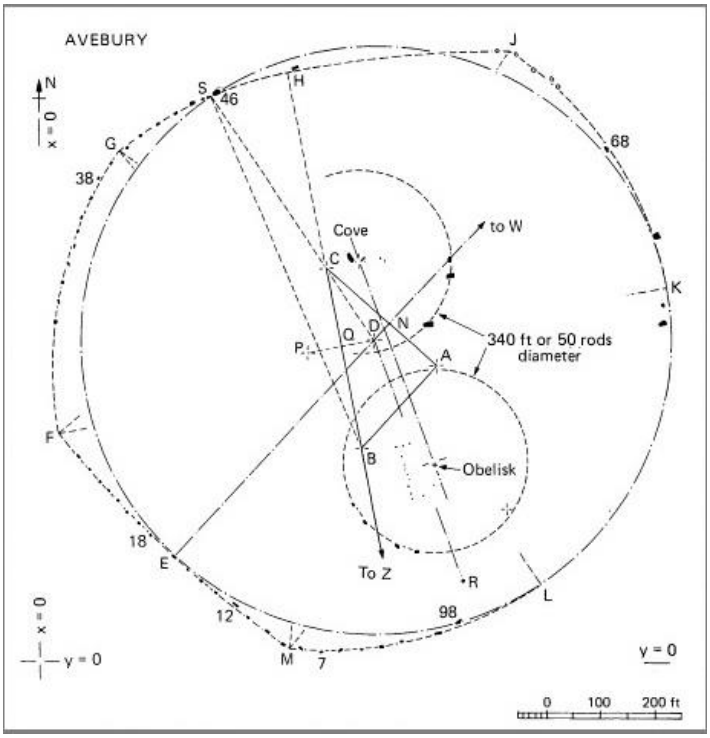

Fig. 45. Plan of Avebury. Source: Thom, Thom and Foord (1976: 185)

The implications of the Basque stone octagons have not been ignored. by researchers outside the Basque Country. For instance, Clive Ruggles, one of the leading figures in the field of archaeoastronomy, has provided the following analysis in "Archaeoastronomy in Europe" which is an overview of current findings in the field:

> Can we use analogy with other cultures to gain any insights into astronomy in the prehistoric British Isles? In the past there have been brave attempts to draw parallels between Mayan astronomer-priests and a supposed astronomical elite in Late Neolithic Britain, responsible for the high-precision observational astronomy envisaged by Alexander Thorn. The twin problems with this approach were first the very different cultural characteristics of the Classic Mayan culture and that of Late Neolithic Wessex, and second the fact that Thom's evidence for high-precision astronomy did not stand the test of reassessment. However, an analogy of great potential interest has emerged recently, from far south in the Basque Country. Here there are many examples of what appear to be eight-stone rings. (Ruggles, 1996:25)

He goes on to say that:

> These *sarobe* were constructed by transhumant shepherding people in historic times, and in some cases they were still in use at the beginning of the twentieth century. This means that we have both first-hand accounts and extensive documentary evidence relating to their purpose and function. This evidence shows that the *sarobe* were actually perceived by the builders as stone octagons rather than stone rings. Legal records specify their design, construction and celestial orientation. Each site was laid out using standard units of length and aligned with the cardinal and inter-cardinal directions. Linked to the theme of cosmic order, it acted both as a seat of government and a center for religious rites. The *sarobe* functioned within a cosmological network of social practices and beliefs rather than merely at an instrumental level. (Ruggles, 1996:25)

Ruggles concludes his discussion of the Basque stone octagons by pointing out their value as a heuristic, a means of rethinking the functions that might have been associated with similar configurations in other parts of Europe, such as Avebury.

> The *sarobe* are the material remnants of a system of the social organisation of space dating back to at least the early Middle Ages, and possibly much earlier. This system is also reflected in constructs and concepts in the Basque language. This language is pre-Indo-European, which provides evidence that Basque culture was not ruptured by the arrival of Indo-European speakers, so that cultural continuity may be postulated right back to prehistoric times. In addition, it is interesting to note that the Basque standard unit of measurement relates to ancient units used to layout traditional land holdings in France and possibly in many parts of the British Isles. These observations do not, of course, prove that cultural practice in the Basque Country in historic and modern times was in any way related to that in the Neolithic and Bronze Age British Isles; they do, however, provide a strong motivation for studying the Basque Country further as a useful analogy for ancient cultural practice elsewhere in Europe, and such investigations are well under way. (Ruggles, 1996:25)

Archaeologists and archaeoastronomers are beginning to recognize the heuristic value of the Basque materials when examining the orientation of megalithic enclosures and earthworks in other regions of Europe.[39] For example, the architectural design and social practices associated with the stone octagons of Euskal Herria might provide new avenues for exploring the way that Neolithic rondels and henges might have been conceptualized and utilized by their builders (Pásztor et al., 2008), a topic that Zaldua Etxabe (2006: 1-14) has also examined in his own writings. And at the same time, palaeoeconomic approaches coupled with the findings of molecular genetics are opening a new window on the question of who the megalith builders of the Atlantic façade might have been as well as the nature of their mode of subsistence. Moreover, there has been a notable methodological and theoretical interest on the part of European anthropologists and archaeologist in tracing cognitive and material continuity across time rather than rupture. And this reorientation of conceptual priorities dovetails with attempts to reconstruct the ethnocultural substratum of the Atlantic Façade and, more concretely, the nature and uses of the septarian units of measurement found across this zone and which have survived in the geometry and symbolic architecture of the Basque sarobe. In short, I am confident that future explorations of this topic will shed further light on these connections.

[39] The Internet has allowed a wider distribution to the work that has been done on this topic, e.g., Zaldua Etxabe (2006). Cf. also Cabezón (2007a, 2007b, 2007c, 2007d), especially the article "Ancient circular enclosures in northern Spain". http://oreneta.com/kalebeul/2007/11/28/ancient-circular-enclosures-in-northern-spain/. This is an English-language translation of the Spanish-language materials found at Cabezón's web site: http://www.leitzaran.net/seles/seles.htm.

8.0 Other implications of the Basque data: Reconstructing the ethnomathematical and ethnocultural substrate along the Atlantic Façade

The material discussed in this chapter represents only one part of a much larger project dedicated to tracing and reconstructing the septarian units of measurement found along the Atlantic Façade, including Ireland, Wales, Scotland and England, and their implementation in social practice. Many of the units of measurement, as noted earlier, survived up until the time of the invention of the decimal metric system and in many locations continued to be employed long afterwards. The fact that the units of measurement tend to be septarian, that is, in the sense that the include units that employ multiples of seven, is a characteristic that makes them stand out. Moreover, as will be demonstrated in future studies, the units are surprisingly abundant and easily recognizable. What is more difficult is interpreting the ways in which the various units fit into the overall system, one that also involves calculating distances on land and at sea. In other words, there are units which were clearly utilized in a systematic fashion to set out distances between locations.

Another facet of the investigation lies in the way that certain units can be traced and compared both in terms of their septarian nature and their linguistic signature. Indeed, there are some expressions that are semantically cognate to expressions found in Basque. These similarieties which are treated in depth in other chapters of this study suggest that we are talking about a system of metrology that was once wide-spread extending all along the Altantic Façade. Moreover, although at this point there is still no way to determine the point in time when the system first came into existence, it is clear that it has survived, albeit in a fragmented fashion, in many locations within this geographic zone.

We need to keep in mind the fact that a metrological system is a socioculturally entrenched entity. Much in the same way that a common language or set of related languages furnish a vehicle for communication and exchange, so does a common system of mensuration. This is why even more than a century after the introduction of the decimal metric system in many locations people still think in terms of ‘feet’ and ‘inches’. In other words, because the associated cultural conceptualizations were so entrenched in social practice, the septarian units of measurement continue to be identifiable and to function, cognitively, as indicators of social practices dating back to much earlier times.

In this respect, the present chapter which has focused on the geometry and symbolic architecture of the Basque stone octagons should be conceptualized as an introductory study, one that will serve to ground the content and interpretation of subsequent investigations into other manifestations of the septarian mensuration system and its use along the Altantic Façade. These studies, already underway, explore applications that this system acquired which extend far beyond tending sheep. In short, the septarian mensuration system opens up new avenues for reconstructing aspects of sociocultural and economic praxis in the Atlantic Façade which until now have been invisible or only faintly detectable.

9.0 The etymology of the terms *sarobe* y *sel &* their geographical distribution

In Euskal Herria these parcels of pastureland go by various names: *sarobe, saroe, sarobi,* and *saroi* in Gipuzkoa, and also by *soro* in Araba and Nafarroa. In Iparralde, the four Basque provinces inside France, they are known as *xara, xarodi, soro* and *kaiolar* (Caro Baroja, 1973: 177-182). In Bizkaia the common term is *korta* or *gorta*. In Gipuzkoa *saroi* and *sarobe* are commonly used. Likewise, all of these terms have given rise to an abundance of toponyms as well as proper names. While the terms found in the semantic field composed by *sarobe, sarobe, saroi, xara, xarodi,* and *soro* all correspond to the same physical entity the etymology of the individual terms is less transparent. For example, the term *saro* appears as the stem of several of them, while *soro* is considered a variant of *saro*.

As for the etymology of *sarobe* there are different theories. From one perspective, it would appear to be a compound expression in which the suffixing element *be/pe* is present, while the root stem of the compound is *saro* 'field, meadow'. The morpheme *be/pe* 'beneath, below' often acts to convey the notion of an 'extension of space' whose specific meaning derives from the meaning of the root stem of the compound. I would note that the voice form *-be* could be interpreted as the older phonological shape of the morpheme, although /b/ and /p/ commonly alternate in Euskara, depending on the phonological environment.

There are many where the spatial component conferred by the suffix is clearly evident. First, from the root stem *estal* 'to cover' we have *estalpe* which refers to the space covered. It translates concretely as 'shelter' and more abstractly as 'refuge, protected area'. This compound can be compared to that of *estalki* 'covering, veil' where the suffix *-ki,* in contrast to *-be/pe*, conveys the notion of the 'object that does the covering', not to the 'space covered'. Anther example consists of *etxabe* and *extape (etxe* "house") where *etxabe* refers again to the 'place' or 'space under the house, under the roof of th house'.

Azkue (1969 [1905-1906]: I, 287) comments, albeit indirectly, on the spatial aspect of the morpheme by defining *etxape* as the 'surface occupied by a house once it is constructed', in contrast to the term *oru, orube* which refers to the 'area, the land upon which the house is to be constructed'. Múgica provides a long list of examples of compounds formed with *-be/pe* (e.g., *harpe* from *harri-pe* 'rock shelter, cave'; *supe* 'fire-place', i.e., 'space under the fire', *lurpe* 'subterranean', i.e. from *lur* 'earth, i.e., space undr the earth"; *urpe* "underwater" from *ur* 'water'; *ostope* 'shaded area under leaves and branches' from *osto* 'leaf' and *gorape* 'atrium' from *gora* 'upper part', etc.) and among them he gives the compound *sarobe,* i.e., *saro-be,* which he defines as 'corral con chozas para ganado' ['a corral with huts for livestock'] (L. M. Múgica, 1978: 210-213).

In this respect, it is noteworthy that in Iparralde we find last names in Sarope and Sarobe (Web, n.d.); Sarobe, e.g. Francisco Javier Sarobe Oyarzun (cf. http://www.webgenealogie.com/titre.php?titre_id=9196&letype=cdrom&lettre=S) as well as farmsteads called Sarobe and Sarobe-Berri, the latter alongside a megalithic tumulus,

near Zarautz, referred to also as Sarobe-Berri (cf. http://www.menosca.com/comunidad/mapa/descarga/pagoeta.pdf.).

On the other hand, others, such as Corominas, have suggested that *saroi* and *sarobe* are compounds derived from *sare* 'net' and phonological variants of *ohe* 'bed', e.g., variants such as *oi*, *oe* and *obe* which are found in Gizpuzkoa. Corominas asserts that *sare* might have meant 'flock of sheep' at some point, arguing from analogy, namely, that in Spanish *red* 'net' is related to *redil* 'sheepfold' or enclosure where sheep are kept at night. In constructing this analogy Corominas sets up a conceptual linkage between the concept 'net' and 'flock of sheep' by arguing it was motivated by the type of fencing used to construct the sheepfold: interwoven stakes forming a kind of webbing. This conceptual linkages is further supported by the Basque dialectal variant *saro* (BN) meaning 'manger' which is derived from *sare* + *o(h)e.*

In his work on this topic Zaldua Etxabe prefers the proposal put forward by Corominas and uses the term *saroi* rather than *sarobe*. In his explanation of the word's etymology he speaks of a "net-like enclosure" which I assume refers to the fences constructed inside the space of the sarobe, the corrals in which the animals were penned at night, rather than to the architectural design of the sarobe itself, made up of the eight outer stones placed on the perimeter and the inner center stone since these stones do not function in any way to restrict the movements of the animals or to bring them together.

> Many have explained what Basque *saroiak* are and in many ways, but if we pay attention to the name (<*sare* 'net' + *ohe* 'bed'), they are places where livestock pass the night, where a net-like enclosure is used to bring the animals together. They are sheltered locations, chosen bec ause of their favorable conditions (orientation, water, slope, accessibility); nonetheless, rather than being enclosures, they are open spaces, that is, originally there was no type of permanent fencing enclosing the space, e.g., no earthern, stone or wooden fence. In Spanish they are called: *cubilar, bustaliza, sel* or *pardina*; in Occitan, *cujala(r)* (> Fr. *cayolar*). In English the expression *pastoral stone octagon* has been used. (Zaldua Etxabe, 2014: 1187)

For additional discussion of the Basque terms used to refer to the stone octagon sites, cf. Corominas ([1954] 1980-1991, IV, 177-178) and Michelena (1987, XIII, 71-72; XIV, 570-571, 853-856).

In Spanish the term utilized is *sel*, found most particularly in Asturias and Santander where a similar system of land parceling is also encountered (Oria M-Conde & Fernández Acebo, 1997). The etymology of the term *sel*, classified by linguists as pre-Roman (Corominas, [1954] 1980-1991, IV, 177-179), is far less transparent than the Basque expressions. Its usage was highly restricted geographically, namely, to Asturias, Cantabria and Bizkaia, zones adjacent to each other along the northern coast and abutting the Bay of Biscay. The geographic proximity of Asturias and Cantabria to the Basque-speaking territory suggests one possible explanation for its etymology: that it derives from a phonologically reduced form of the Basque word *zelai* 'field, meadow, pasture; flat open area, plateau', which is a cognate or synonym of *soro* in the area of Oiarzun, Irun and Ondarribia. The proposed evolution of *sel* would be: **zel(ai)* > **zel* > *sel.* Indeed, dialectal

variants of the *zelai* found in Basque itself, e.g., *zelei, selai, xelai, sela* (V, G, AN), demonstrate the phonological path taken by the term as it evolved: *zelai* > *zelei* > **zele* > **sele* > *sel*. In its citation form in Euskara *zelai* becomes *zelaia* and is found as a relatively common last name, spelled as Celaya, Zelaya and the Santander town named Selaya. This interpretation would situate the Basque word *zelai* as the etymon for the term *sel* used in the geographically adjacent zones of Santander and Asturias.

This etymology is proposed and discussed at some length in García Lomas (1960: 278-280). On the other hand, Corominas ([1954] 1980-1991, IV, 177-179) rejects this etymology and prefers one that sets up **sele* as an old Ibero-Basque word which passes almost directly into Romance as *sel*, but changes quite significantly when it went into Basque: **sele* > **sere* > **sare*. Nonetheless, the proposal by Corominas requires the following somewhat unusual developmental pattern to have governed the evolution of the term: 1) that a semantic item from a substrate language passes into Romance, here Asturian and, for example, Bable, a unique dialect spoken in Santander, but without any significant change to its phonological structure; and then 2) that the same term, viewed as belonging to the hypothesized *ibero-vasco* substrate, passes into Basque—which is one of the substrate languages—in a significantly modified form. If we were to use Occam's Razor, it would be much simpler—and more straight forward—to propose that *sel* evolved directly from phonological variants of *zelai*. Furthermore, in Basque we find *sela* (V, G, AN) being used alongside *sel* as a synonym of *saroi*. A similarly shaped phonological stem shows up in compounds in which the second element is *buru* "head": *selaburu, sela(bu)ru, zelaburu, zela(bu)ru, selai(bu)ru* (Michelena, 1987, IV, 662) where the original phonological shape of the stem appears to be *zelai*. In short, there are several intriguing etymological possibilities available to the researcher.

In Santander the term *sel* is found copiously in toponyms, but, in contrast to the Basque-speaking region, when we consider the availability of the information for Santander concerning exactly how the sites were laid out, few details are available. Speaking of the region of Pas, García Lomas (1960: 273) defines the *sel* as "lugar abrigado y limpio de maleza, acotado en círculo con piedras grandes, en el que se recogen por la noche los ganados para dormir" ["a site well protected and free of brush, surrounded by a circle of large stones, in which the livestock takes refuge at night to sleep."]. It is not clear from this description how large the stones actually were or how many were placed at the perimeter of each site. Furthermore, with respect to the antiquity of the term *sel* in this region, he mentions "la notable obra de Escagedo Salmón publicado bajo el título de *Costumbres pastoriles…*, en la cual su autor transcribe la escritura por la que los Obispos Severino y Arnulfo donan bienes a Santa María de Yermo (año 853), y deduce de las palabras: 'Et in territorio de Campo braneas Pascua quas vulgus dicit seles' lo siguiente: 'Esta frase, y otras que pudiera apuntar, nos prueban que aún a mediados de la novena centuria no era el latín en nuestra provincia el lenguaje del pueblo, sino un idioma que nos es hoy completamente desconocido, pero que subsiste en la toponimia de los lugares

montañeses que no son de raíz latina. La copia referida la creemos apócrifa, pero el laborioso cronista vuele a insistir (pág. 109) en su obra y apunta la longevidad del vocablo 'Sel' manifestando que es palabra cántabra, a juzgar por el documento mencionado. ['the notable work of Escagedo Salmón published under the title of *Costumbres pastoriles*…, in which its author transcribes a document by means of which the Bishops Severino and Arnulfo donate goods to Santa María de Yermo (in the year 853), and deduce from the words 'Et in territorio de Campo braneas Pascua quas vulgus dicit seles' the following: 'This phrase and others that I could point out, prove to us that even at the middle of the ninth century in our province Latin was not the language the people (popular classes), but rather a language that today is totally unknown to us, but which survives in the toponyms of mountainous locations that do not have Latin roots.' We believe that the copy cited is apocryphal, but the hard-working chronicler insists once again in his work and points out the longevity of the term 'Sel', arguing that it is a Cantabrian word, based on the aforementioned document."] (García-Lomas, 1960: 275).

10.0 Conclusions [to be written]

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